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MAINTENANCE MANUAL

YELLOW COACH

Models

PGG 37 & 41 — PDG 37 & 41

Yellow Coach

Maintenance Manual

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GENERAL MOTORS TRUCK & COACH
DIVISION OF
YELLOW TRUCK & COACH MANUFACTURING COMPANY
PONTIAC, MICHIGAN

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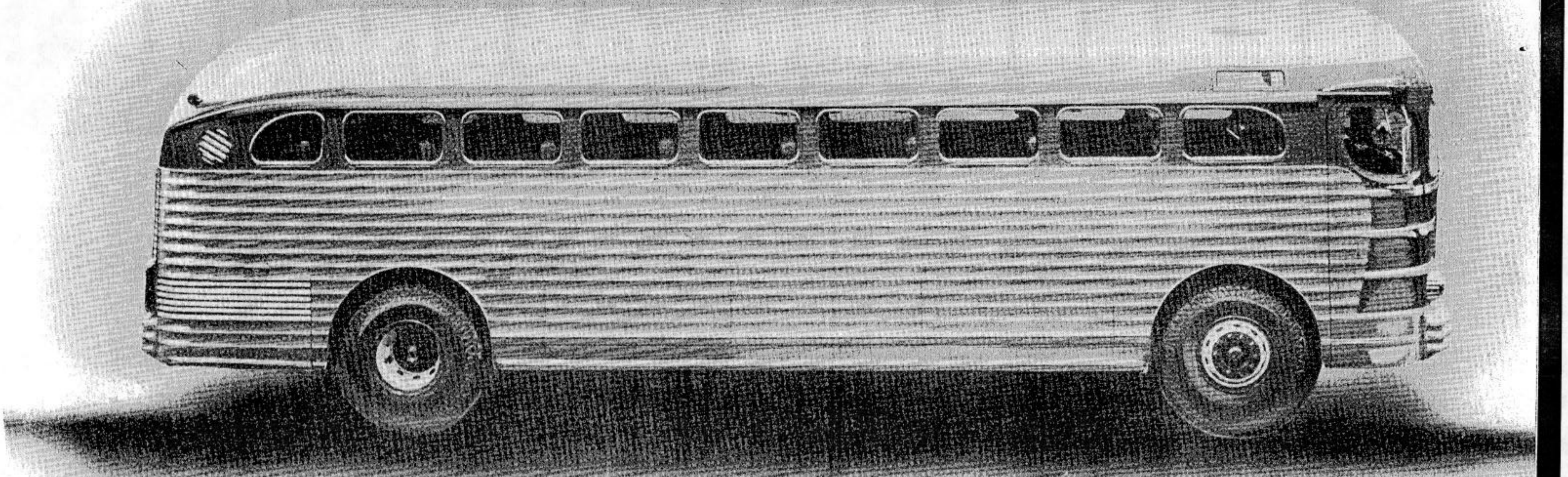


Yellow Coach—Models PGG-PDG 37 and 41

Introduction

This publication contains complete descriptive information and maintenance data on models shown below. The suggested maintenance procedure given will assist in obtaining continued economical and trouble-free operation.

As in previous manuals, this book is conveniently arranged in groups. A quick index appears on Title page, and each group throughout book has black tabs showing these same numbers.

Model Designation

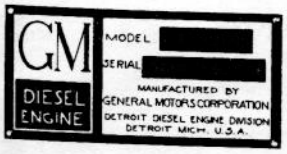
Vehicles covered by this publication are as follows:

MODELS PGG, PDG - 37 & 41

Serial Number Locations

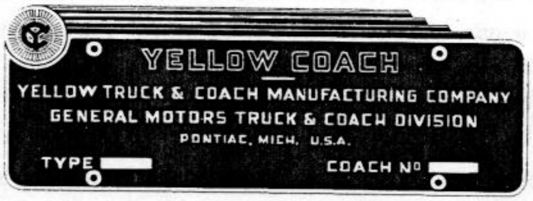
Delay and confusion can be avoided when correct serial numbers of vehicle are specified on parts orders and correspondence.

The following illustrations show where numbers appear on this particular model. (Serial numbers shown in these pictures are only typical and therefore must not be quoted.)



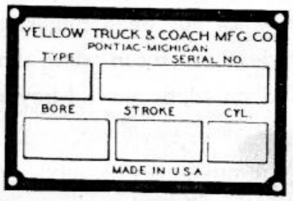
Engine Number (Diesel)

Plate on left hand side of engine.


YELLOW COACH
YELLOW TRUCK & COACH MANUFACTURING COMPANY
GENERAL MOTORS TRUCK & COACH DIVISION
PONTIAC, MICH. U.S.A.
TYPE
COACH No

Chassis Number

Plate on inside of body, above or below windshield.



Engine Number (Gasoline)

Plate on left hand side of engine.

Form Number

This publication is identified by a Form Number. Specify this number in all references to this book.

FORM No. X-4031

Printed in U. S. A.

WARRANTY

Yellow Truck & Coach Manufacturing Company's products are subject to the following warranty:

Warrant each new commercial motor vehicle manufactured by us to be free from defects in material and workmanship under normal use and service, our obligation under this warranty being limited to making good at our factory any part or parts thereof which shall be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective provided that such part or parts shall be so returned to us not later than ninety (90) days after delivery of such vehicle to the original purchaser, and that at the time of such return, the said vehicle shall not have been operated in excess of five thousand (5,000) miles. This warranty is expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on our part, and we neither assume nor authorize any other person to assume for us any other liability in connection with the sale of our vehicles.

This warranty shall not apply to any vehicle which shall have been repaired or altered outside of our factory in any way so as, in our judgment, to affect its stability, or reliability nor which has been subject to misuse, negligence or accident, nor to any commercial vehicle made by us which shall have been operated at a speed exceeding the factory rated speed, or loaded beyond the factory rated load, capacity.

We make no warranty whatever in respect to tires, rims, ignition apparatus, horns or other signaling devices, starting devices, generators, batteries, speedometers or other trade accessories inasmuch as they are usually warranted separately by their respective manufacturers.

GENERAL MOTORS TRUCK & COACH
DIVISION OF
YELLOW TRUCK & COACH MANUFACTURING COMPANY
PONTIAC, MICHIGAN

General Data

Models PGG-37 and 41

Wheel Base - PGG 37	240"
PGG 41	264"
Engine Model	707
Bore	5"
Stroke	6"
Piston Displacement - Cu. In.	706.85

CAPACITIES

Fuel Tanks (Gals.) Does Not include Air Conditioning	120
Engine Crankcase (Qts.)	24
Cooling System (Includes Heating System)	
Model PGG 37 - Qts.	68
Model PGG 41 - Qts.	69
Transmission (Qts.)	9-1/2
Rear Axles (Qts.)	9

Models PDG-37 and 41

Wheel Base - PDG 37	240"
PDG 41	264"
Engine Model	6.71
Bore	4-1/4"
Stroke	5"
Piston Displacement (Cu. In.)	426

CAPACITIES

Fuel Tanks (Gals.) Does not include Air Conditioning	120
Engine Crankcase (Qts.)	27
Reserve Oil Tank (Qts.)	12
Cooling System (Includes Heating System)	
PDG 37 - Qts.	63-1/2
PDG 41 - Qts.	64-1/2
Transmission - Qts.	9-1/2
Rear Axle - Qts.	9

Governor Settings

Diesel and Gasoline Engines

Axle Ratio (Standard)	3.5 to 1
1st, 2nd and 3rd Speed	1850 RPM
4th speed	1650 RPM
Axle Ratio (Special)	3.15 to 1
1st, 2nd and 3rd Speed	1725 RPM
4th Speed	1550 RPM
Axle Ratio (Special)	4.09 to 1
1st, 2nd and 3rd Speed	1975 RPM
4th Speed	1750 RPM

Group Index

Instructions and Illustrations Covering Various Units in These Vehicles are Shown in Following Groups:

Group Name	Group No.
Front Axle	1.7601
Rear Axle	2.10281
Body	3.1701
Brakes	4.10401
Clutch	5.8401
*Cooling System	6.7801
Wiring	7W.0001
Starting Motor and Battery	7S.0001
Distributor,Coil and Spark Plugs	7D.0001
Generator and Control	7G.0001
Lighting Equipment	7L.0001
Misc. Electrical Equipment	7M.0001
*Engine (Gasoline)	8.7101
*Fuel System (Gasoline)	12.8901
Lubrication	13.371
Springs	15.6381
Steering Gears	16.7701
Transmission	17.11101
Propeller Shafts	18.7101
Wheel, Hubs and Bearings	19.9101

NOTE: Instructions and Illustrations applying to Diesel engine operation,including basic engine, fuel and cooling systems, are shown in Diesel Operating Manual. Specific references to Diesel operations are made in other groups when necessary to distinguish between Diesel and gasoline engine application.

Front Axle

Instructions and Illustrations in this Group Apply to Following Subjects:

Front Axle Assembly
Axle Center
Steering Knuckles
Stop Screws
Tie Rod
Lubrication
Front End Alignment
Specifications

Instructions Applying to Related Parts of the Front Axle will be Found in Following Groups:

Name	Group No.	Name	Group No.
Front Wheels, Hubs	19.9101	Front Springs	15.6381
Front Brakes	4.10401	Shock Absorber	19.9101
Steering Connecting Rod	16.7701	Steering Gear	16.7701

FRONT AXLE ASSEMBLY

Front axle assembly discussed and illustrated in this group is Reverse Elliott type with rectangular axle center. Hubs, wheels, wheel bearings, tires and other related parts are discussed in other groups of this book as listed above.

Specifications and important service data are listed at end of group. Fig. 1 shows relative position of component parts of steering knuckle and steering arms. Figs. 2 and 3 illustrate tie-rod assembly. Front End Alignment Chart illustrates typical alignment points keyed to alignment specifications listed at end of alignment section.

REMOVING AXLE ASSEMBLY

If facilities permit, front end of body can be hoisted high enough to permit removal of entire axle unit (including springs) however, it is recommended that springs be removed from axle at spring clips and axle unit be withdrawn from vehicle in following manner:

1. Hoist up front end of vehicle to take load off of springs.
2. Remove spring center clips.
3. Remove spring center bolt lubrication fittings. These fittings are screwed into axle center on under side.
4. Disconnect air lines and steering connecting rod at axle.
5. Place dolly or jack under axle beam and remove wheels.
6. Axle may then be withdrawn from vehicle. When axle is reinstalled, the spring clip nuts should be tightened equally and with the same degree of effort. Uneven tightening of clip nuts will effect axle caster.

FRONT AXLE CENTER

Front axle center or I-beam which has been twisted or bent more than 5° from original shape, should be replaced with new part. Experience has shown that axle parts which have been twisted or bent more than 5° are generally distorted beyond their material elasticity limits. As a general rule, when an extreme bent condition exists, minute fractures hardly visible, will occur. Failure under ordinary operating conditions usually result.

The straightening of any axle forgings must be performed by mechanics who are thoroughly familiar with such operations and the use of special straightening tools.

USE OF HEAT

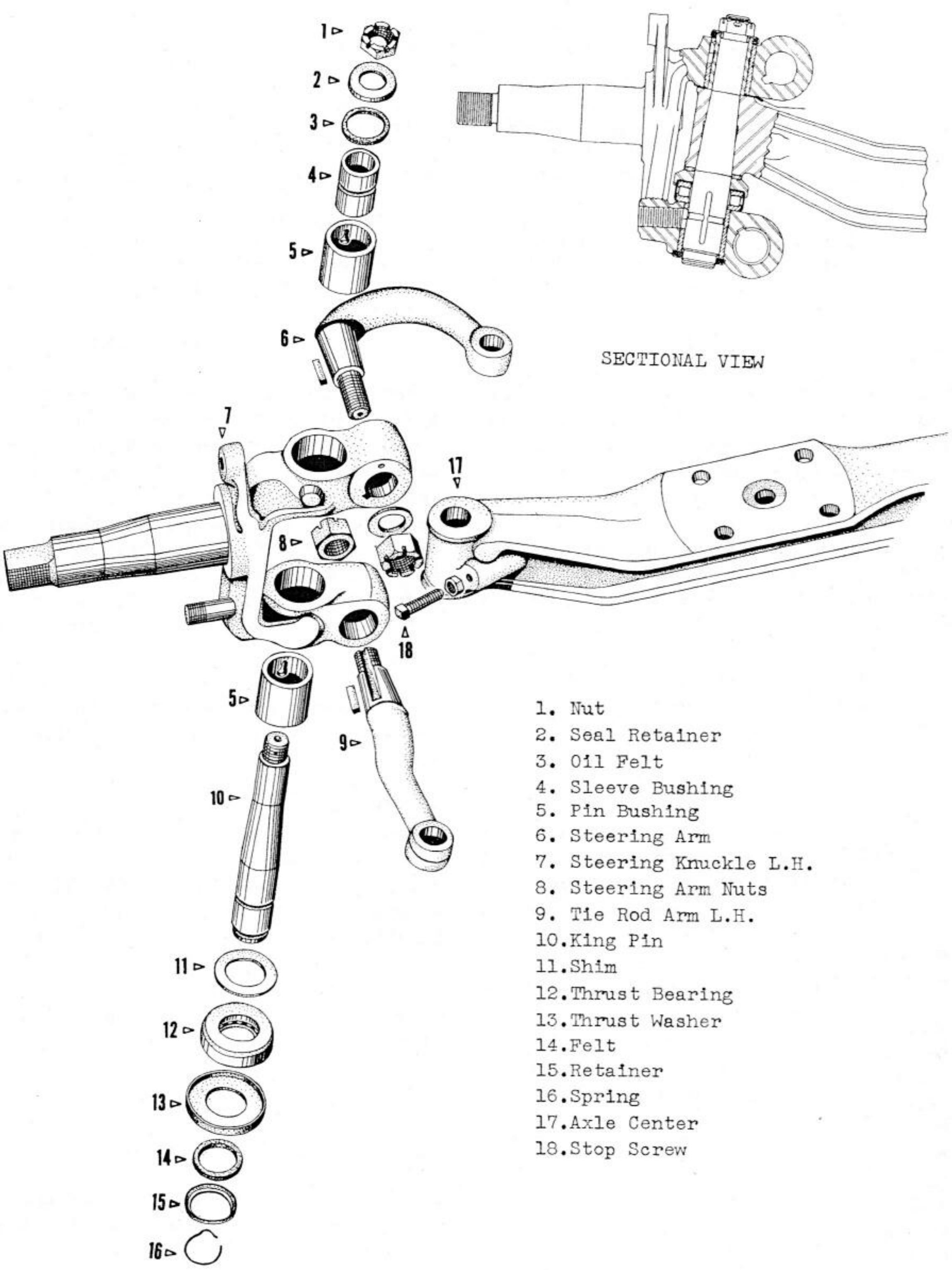
Application of heat to assist straightening operations weakens the material strength of all axle forgings. ALWAYS STRAIGHTEN FORGINGS - COLD - UNDER NO CIRCUMSTANCES SHOULD HEAT BE APPLIED.

CHECKING AXLE CENTER

Axle center may be checked for twist with alignment instruments or on bench as illustrated in Alignment Chart.

STEERING KNUCKLE

Each steering knuckle is mounted to and swivels on axle center end with king pin as illustrated. Steering knuckle body is bushed for king pin at lower end and for pin bearing sleeve at upper end with bronze bushings, line reamed after assembly to dimensions listed in "Specifications".



1. Nut
2. Seal Retainer
3. Oil Felt
4. Sleeve Bushing
5. Pin Bushing
6. Steering Arm
7. Steering Knuckle L.H.
8. Steering Arm Nuts
9. Tie Rod Arm L.H.
10. King Pin
11. Shim
12. Thrust Bearing
13. Thrust Washer
14. Felt
15. Retainer
16. Spring
17. Axle Center
18. Stop Screw

Fig. 2 Front Axle Parts and Sectional View.

When installing new bushings, round off edges slightly, then place in position with oil holes lining up with lubrication fittings. Press in square with arbor press - do not drive in with hammer.

Line-ream bushings after installation in knuckle body. Use regular two stage reamer or one with pilot bar. Flutes of reamer should be long enough to finish ream both bushings in one operation. Flush off all shavings - then lubricate liberally with regular chassis lubricant.

STEERING KNUCKLE PIN

Steering knuckle pin is tapered to register with tapered portion of axle center end. Upper portion of pin is mounted in a steel bearing sleeve which fits into upper knuckle body bushing. When nut at top of pin is drawn tight, pin seats firmly in taper of axle center end.

Felt oil seal and retainer cup at bottom of pin is held in place with snap ring which fits into grooved section of pin. Upper oil seal and retaining ring is held in place by king pin nut.

REMOVING STEERING KNUCKLE ASSEMBLY

Steering knuckle assembly may be removed from axle for repair purposes without necessity of withdrawing axle unit if desired.

1. Jack up front end of vehicle.
2. Remove front wheel, hubs, drums, brake shoes and attaching parts.
3. Disconnect tie-rod and steering connecting rod at knuckle.
4. Back off nut on upper end of king pin. Pin can be loosened with sharp blows on nut with brass or babbitt hammer. Remove nut and drive pin out.
5. Remove knuckle, thrust bearing, washers, shims, and oil seals.

INSTALLING STEERING KNUCKLE ASSEMBLY

Examine all parts for wear. Renew oil seals and retainers if necessary. Assemble knuckle and pin to axle center in order given. Lubricate all parts liberally at assembly.

1. Install oil seal, retainer, and snap ring on lower end of pin(14, 15, and 16 - Fig. 1).
2. Install thrust bearing and thrust washer in place on knuckle (12 and 13, Fig. 1). Insert pin through bottom temporarily.
3. Jack knuckle up just enough to put load on thrust bearing. Check clearance between upper face of axle center end and knuckle to determine shim thickness necessary to keep up and down movement within limits listed in "Specifications".
4. Partially withdraw pin to permit insertion of necessary shims (See "Specifications" for shim sizes).
5. Install bearing sleeve (4 - Fig. 1) over upper end of king pin.
6. Install top oil felt and retainer (2 and 3 Fig. 1). Draw nut down firmly so that pin seats in tapered portion of axle center end.
7. Clean and lubricate wheel bearings as described in "Wheels and Bearings" group 19.
8. Install hubs, bearings, and brake parts. Adjust brakes and wheel bearings as described in groups 4 and 19 of this book.

STOP SCREWS

Adjustable stop screws installed in axle center ends at steering knuckles limit turning angle of front wheels. The primary purpose of these stop screws, when correctly adjusted, is to prevent steering gear mechanism from bottoming when wheels are turned at extreme angles. These screws also prevent tire interference with chassis or frame.

The adjustment of stop screws is an important operation. If stop screws are adjusted to provide excessive clearance, the normal turning radius may be decreased. If the clearance is not sufficient, the angle of wheel on a turn will be excessive. Such a condition will cause steering mechanism to bottom and result in damage to that unit.

Stop screws should be adjusted to provide at least 1/2" clearance between extreme portion of wheel and nearest chassis point. Stop screws should be adjusted with steering connecting rod disconnected at axle. Wheels should then be forced to extreme right and screw adjusted to allow 1/2" clearance. Then screw should be backed out 1 or 1/2 turns. Repeat on left wheel. Connect steering connecting rod to axle arm.

With stop screws adjusted in this manner, they will contact steering knuckles before extreme left or right position of steering gear is reached.

TIE ROD

Tie rod end assemblies are threaded into tubular portion of rod, and clamped to threaded portion with two clamp bolts. The rod proper has right and left hand threads to facilitate adjustment.

End assemblies are ball bearing type and are self adjusting for wear. Lower end of ball stud forms inner case for two rows of ball bearings. Spring at lower end of stud maintains constant ball clearance. The end assemblies are serviced complete or can be disassembled for replacement of worn parts. (See Fig. 3).

End cap is threaded into body of end assembly and can be removed after cap lock and screw is withdrawn. End assembly can then be completely disassembled after steering arm is removed from stud.

Before reassembling, examine all component parts carefully, and replace worn parts. If necessary to disassemble end for replacement parts, dust shield pad should always be replaced.

End cap should be drawn up to seat firmly against edge of outer bearing race. NO ATTEMPT SHOULD BE MADE TO COMPENSATE FOR WEAR OF BALLS BY SCREWING END CAP INTO HOUSING. End cap merely holds parts in place and any attempt to tighten cap to compensate for wear will result in failure of engine assembly. When cap is screwed into place make sure that dimension of 1/32" exists between outer surface of cap and body as illustrated in Fig. 2.

TOE-IN ADJUSTMENT

When necessary to change length of tie rod assembly for toe-in correction, loosen clamp bolts at each end of tie rod. Rod can then be turned in either direction to obtain desired toe-in. After adjustment is made, tie-rod ends should be in same plane before clamp bolts are tightened. Tie rod ends must not bind on balls when wheels are turned in either extreme right or left positions.

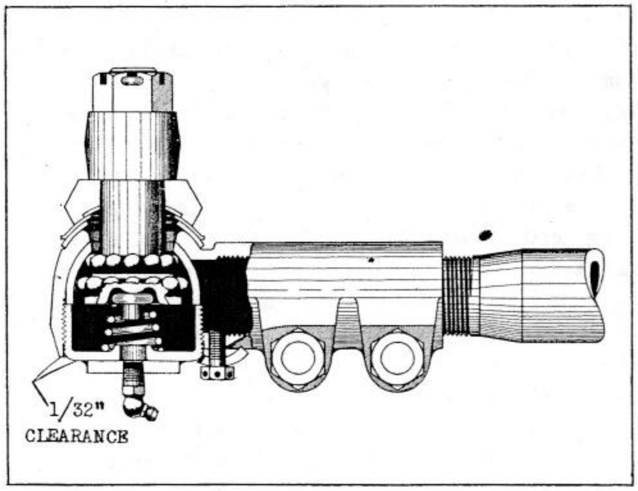
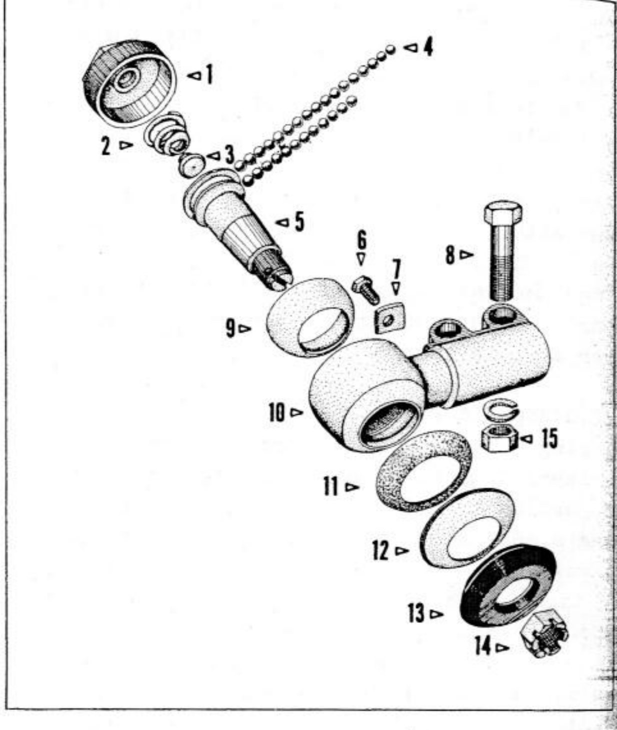


Fig. 2 Tie Rod End Construction



1- End Cap Assembly
2- Ball Stud Pivot Pin Spring
3- Ball Stud Pivot Pin
4- Ball Stud Bearing Ball
5- Ball Stud
6- End Cap Lock Screw
7- End Cap Lock
8- Housing Clamp Bolt
9- Ball Stud Bearing Ball Cup
10- Tie Rod End Assembly
11- Dust Shield Pad
12- Dust Shield Cup
13- Dust Shield Cap
14- Ball Stud Nut
15- Clamp Bolt Nut

Fig. 3 Tie Rod End Assembly Showing Relative Position of Component Parts

LUBRICATION POINTS

Lubrication points on front axle parts discussed are as follows:

1. One lubrication fitting at upper and lower part of knuckle on each side (total of four fittings).
2. One lubrication fitting at top of tie rod end on each side (total of two fittings).

Lubrication points on front springs, wheel bearings, and front brakes are described in their respective groups (groups 15, 19 and 14).

FRONT AXLE

FRONT END ALIGNMENT

The deflection of tires under weight of vehicle, vibrations of chassis and steering parts due to irregularities of road, and other normal physical actions and forces, will tend to produce forces of sufficient magnitude and frequency to cause misalignments in front end system.

In order to prevent undesirable effects of these normal forces, it is important that various factors of steering system be properly balanced, and that all units comprising the front end and wheel suspension systems be in good mechanical condition and adjustment.

In brief, instructions relating to front end alignment outlined in this group should be carefully followed as well as instructions covering other related units such as steering gear, wheels, brakes, and tire inflation. These related instructions will be found in their respective groups i.e. "Steering Gear", "Brakes", and "Wheels".

The service man should be thoroughly versed with basic factors of steering and front end systems in order to logically diagnose and correct misalignments. In addition to a thorough knowledge of systems and the adherence to alignment specifications listed in "Specifications" section of this group, presicion equipment and instruments should be made available for accurate check up and corrective work.

FRONT END ALIGNMENT FACTORS

Front end alignment factors discussed in this group include:

FRONT WHEEL TOE-IN
FRONT WHEEL CAMBER
AXLE CASTER
KING PIN INCLINATION
STEERING GEOMETRY

Where necessary, reference is made to other related alignment factors discussed in other groups in this book.

Alignment terms discussed in this group are:

WHEEL TOE-IN - Distance front wheels are closer together at front than at rear of axle (See "J" and "H" on Chart).

WHEEL CAMBER - or pitch - The amount wheel incline at the top from a vertical position - POSITIVE camber is outward inclination of wheels at top (See "C" on Chart). ZERO Camber - means no inclination - wheels are held in vertical plane.

NEGATIVE OR REVERSE camber - is an inward inclination of wheels at top.

FRONT AXLE CASTER is the amount in degrees that steering knuckles are tilted toward front or rear of vehicle.

POSITIVE caster is inclination of knuckles toward rear of vehicle (See "N" on Chart).

ZERO caster is vertical position of pins.

NEGATIVE or REVERSE caster is an inclination of top of pins toward front of vehicle.

KING PIN INCLINATION - amount king pins are inclined inward at the top (See "D" on Chart).

STEERING GEOMETRY - the mechanics of keeping front wheels in proper relative alignment as wheels are turned to extreme right or left.

FRONT WHEEL TOE-IN

The purpose of toe-in is to offset the effect of camber, preventing side slippage and cross wear of tires. Camber and toe-in bear a definite relation to each other, therefore both should be checked at the same time.

Where maximum allowable camber exists, wheels should be adjusted for maximum allowable toe-in.

Toe-in is usually measured from centers of tire treads at height of wheel centers (See "J" and "H" on Chart). However toe-in readings can only be obtained accurately with instruments designed for that purpose. Toe-in should always be measured with wheels in straight ahead position.

Refer to "Wheels" group for instructions on tire inflation. Tire inflation definitely affects toe-in and camber.

FRONT WHEEL CAMBER

The purpose of camber (See "C" on Chart) is to offset deflection and wear of front axle parts, preventing wheels from going into REVERSE camber after long service.

The result of excessive POSITIVE camber is irregular wear of tires on outside shoulders. Excessive positive camber is usually caused by bent parts.

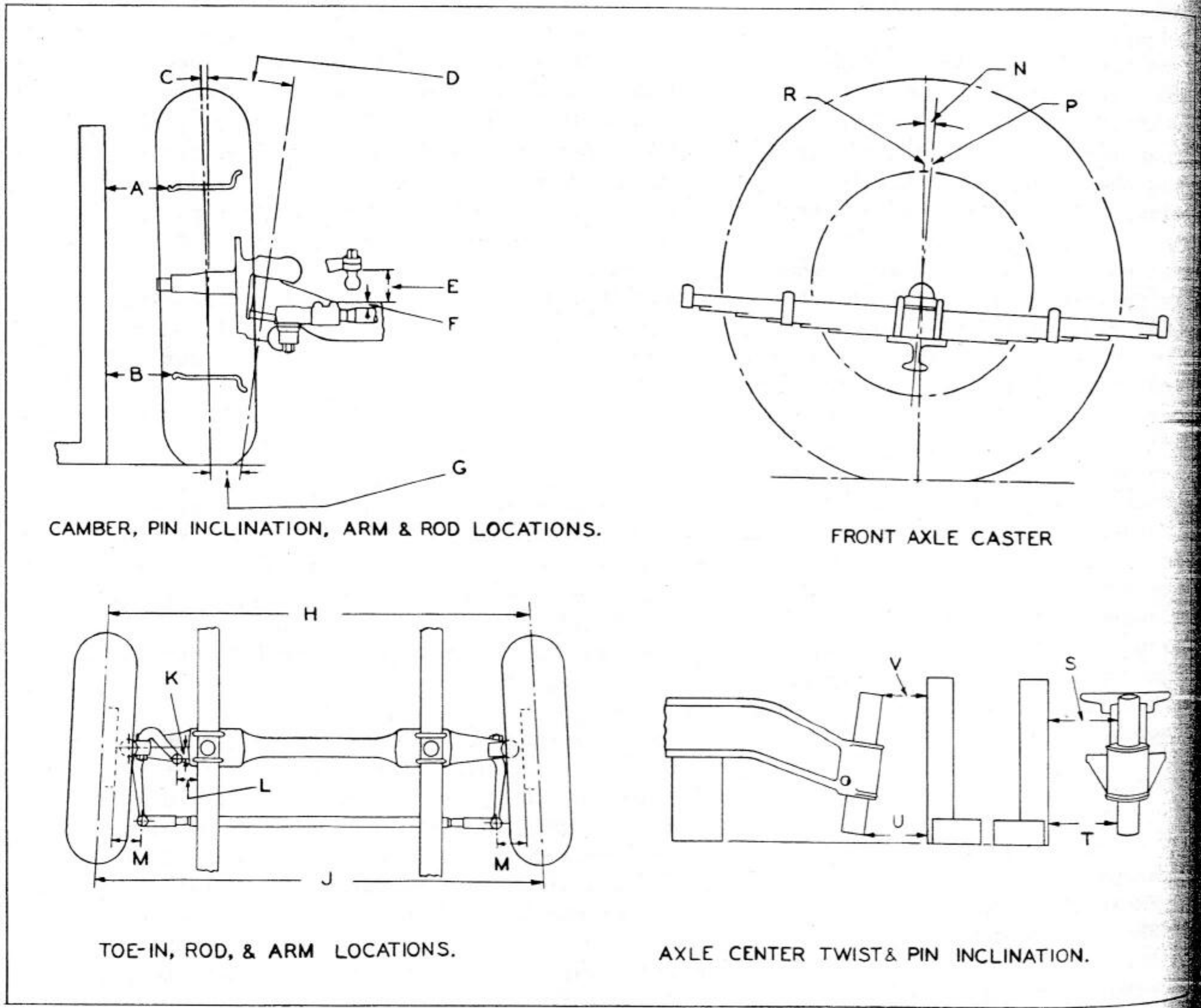
The result of NEGATIVE or REVERSE camber,

FRONT AXLE

FRONT WHEEL ALIGNMENT CHART

IMPORTANT

A complete analysis or correction of Front Wheel Alignment cannot be accomplished unless all related units are checked or corrected.



CAMBER, PIN INCLINATION, ARM & ROD LOCATIONS.

FRONT AXLE CASTER

TOE-IN, ROD, & ARM LOCATIONS.

AXLE CENTER TWIST & PIN INCLINATION.

LEGEND

B Minus A - - - - - - - - - - - - - - - Camber (Inches)
C - - - - - - - - - - - - - - - - - - Camber (Degrees)
D - - - - - - - - - - - - - - - - - - - Pin Inclination
E - - - - - - - - - - - Drag Link Arm Above Spring Seat
F - - - - - - - - - - Top of Tie Rod Below Spring Seat
G - Tire Overhang
J Minus H - - - - - - - - - - - - - - - - - - - Toe-In
K - - - - - - - - - Relation of Link Arm to Axle Center

L - - - - - - - Center of Link Arm to Edge of Spr
M - - - - - - - - - - Center of Rod Ball to Rim Ba
N - - - - - - - - - - - - - - - - - - - Caster Ang
P - - - - - - - - - - - - - - - - - - Knuckle Pin
R - Vertic
T Minus S - - - - - - - - - - - - - - - - I Beam Twi
U Minus V - - - - - - - - - - - - - - - Pin Inclinati
Refer to "Specifications" for Correct Dimension

is excessive, will be hard steering and possibly wandering condition. Tires will also wear on inside shoulders. Negative camber is usually caused by excessive wear or looseness of front wheel bearings and king pins, or the result of a sagging axle. A SAGGING AXLE MAY BE CAUSED BY USE OF HEAT WHEN STRAIGHTENING.

The result of UNEQUAL CAMBER may be any or a combination of following conditions: Unstable steering - wandering - kick-back or road shock-shimmy - excessive tire wear. The cause of unequal camber is usually a bent steering knuckle or axle center.

CHECKING CAMBER

Before checking camber, the vehicle should be jacked up at front axle for inspection of wheel bearings and king pins. Excessive looseness of king pins may be checked with a camber gauge attached to wheel. Pull outward at bottom of wheel to take up all slack in bearings and pins - then take a camber reading. Pull outward at top of wheel and take another reading. If the difference between the two readings exceed $1/4^{\circ}$ make following adjustments and checks:

1. Adjust wheel bearings as described in "Wheels" group. Then take another camber reading as described in preceeding paragraphs. If difference is more than 1/4, replace knuckle bushings and pins.
2. Check run out of wheel at rim. If run-out or wobble is excessive, straighten or replace wheel.
3. Vehicle should be placed on level floor with full weight on wheels to make final camber reading. It is recommended that an accurate camber gauge be used,- however if a camber gauge is not available, readings can be taken as illustrated at "A" and "B" on chart. Place square as shown and measure distance between "A" and rim, and "B" and rim. Lower dimension should exceed upper dimension by amount listed in "Specifications" section. This dimension on right wheel should not vary over 3/32" with same dimension of left wheel.
4. CAMBER ERROR - An error in final camber reading usually indicates a bent axle center or knuckle.
5. To determine whether knuckle or axle center is bent, the KING PIN INCLINATION ("D") should be checked. By adding camber to king pin inclination ("C" plus "D"), the INCLUDED ANGLE of steering knuckle is obtained. If there is a difference of $1/2^{\circ}$ between the included angle of left knuckle and right knuckle, replace the knuckle which is bent.

AXLE CASTER

The purpose of caster (See "N" on Chart) is to provide steering stability which will keep front wheels in a straight-ahead position and to assist in bringing wheels out of a turn on curve. Caster also controls vibrations and gyroscopic motion of front wheels thereby reducing tendency to shimmy.

The result of NEGATIVE caster is wandering of the vehicle will not come out of turn normally. The cause of negative caster may be sagging or dislocated springs, or bent axle center.

Caster angle is obtained on some vehicles with tapered shims placed between springs and axle pads. In some instances no caster shim is used. Refer to "Specifications" section for amount of caster and method used.

Uneven tightening of spring clip bolt nuts will definitely affect caster. Tighten both sides equally and with same degree of effort.

KING PIN INCLINATION

King pins are inclined (See "D" on Chart) to decrease frictional resistance of tires against the road when turning right or left. Special precision instruments should be used to check inclination; however a check can be made on bench as shown on chart.

Rest spring seats on blocks as shown. Make check on perfectly level surface. Use square at both ends as shown and measure distance from both ends of king pin and vertical edge of square (See "V" and "U" on Chart). Difference between "U" dimension and "V" dimension should be same as shown in "Specifications" section. Axle center twist can also be checked as shown at "S" and "T" on Chart).

STEERING GEOMETRY

Steering geometry is the mechanics of keeping front wheels in proper relative alignment as the wheels are turned to extreme right or left. It is sometimes called steering error or steering angularity. The governing factors in steering geometry are the length and angularity of the steering arms and linkage. As a greater part of all driving is done on angle of turns, steering geometry becomes one of the most important factors of front wheel alignment.

Steering error in combination with excessive camber is chiefly the cause of uneven tire wear. Elimination of this error reduces tendency to skid on turns, permits greater application on front wheels in turning, and improves steering and tire wear.

It is recommended that special equipment be used to check for steering geometry error.

The following points to check in addition to those previously described are:

See Chart.

1. Relative position of drag link arm to axle spring seat - "E" on chart.
2. Relative position of tie rod to spring seat - "F" on chart.
3. Relative position of drag link arm to center line of axle center - "K" on chart.
4. Relative position of drag link arm to spring edge - "L" on chart.
5. Relative position of each end of connecting rod to rim base - "M" on chart.

SPECIFICATIONS

Type----------------------Reverse Elliott
Spring Centers ------------------------42"
Steering Knuckle Bushing
Inside Diameter.------------1.717"-1.718"

Clearance Between Bushing and Pin---.000"-.002"
Up and Down Movement-----------------.015"
Shim Sizes Available---------.010"and.020"

WHEEL ALIGNMENT SPECIFICATIONS

(See Page 1.7606)

"B" Minus "A"	- Wheel Camber (at 18")----------------------------	5/16"
"C"	- Wheel Camber--------------------------------------	1°
"D"	- King Pin Inclination-----------------------------	5-1/2°
"E"	- Bottom of Drag Link Arm Above Spring Seat-------	2-1/8"
"F"	- Top of Tie Rod Below Spring Seat----------------	1-5/8"
"J" Minus "H"	- Toe-In------------------------------------	1/16" to 1/8"
"K"	- Relation of Link Arm to Axle Center-----	on Center Line
"L"	- Center of Drag Link Arm to Edge of Spring-----	2-11/16"
"M"	- Center of Tie Rod Ball Stud to Base of Rim------	1-7/8"
"N"	- Caster Angle (No Shims)--------------------------	1/2°
"T" Minus "S"	- Axle Center Twist--------------------------------	Equal
"U" Minus "V"	- King Pin Inclination-----------------------------	7/8"

Rear Axle

Instructions and Illustrations in This Group Apply to Following Subjects:

- Differential
- Differential Carrier
- Drive Pinion
- Axle Shafts
- Gear Adjustment
- Lubrication

Instructions Applying to Related Parts of Rear Axle Will be Found in Following Groups:

Name	Group
Wheel Bearings	19.9101
Wheel Brakes	4.10401
Sway Bar	15.6381

Rear axle is angular spiral bevel gear drive, full floating type with one piece "bowl" type housing. See Fig. 1. Housing bowl is offset toward right of chassis. Drive pinion assembly is mounted at angle as illustrated. Drive is transmitted from transmission angle-mounted output shaft through propeller shaft.

DIFFERENTIAL CARRIER

Differential assembly, and angle mounted pinion shaft assembly are mounted in differential carrier which must be removed from housing for repair.

DIFFERENTIAL

Differential is four pinion type mounted in two-piece case, hubs of which are mounted on adjustable tapered roller bearings. Bearings are adjusted for wear as explained under "Removal and Installation".

Bevel drive gear is attached to flanged half of differential case with special bolts. Drive gear and pinion are furnished in matched lapped sets and should always be installed as such to assure satisfactory operation. Noisy operation and rapid wear are almost certain to result if new gear is used with old pinion or vice versa.

Differential case is machined as complete assembly; therefore separate halves of case are not available. When reassembling case, it must be put together with marks in line. If marks are not legible when disassembling, mark both halves with punch to facilitate assembly.

Bronze thrust washers are used between side gears and case, and differential pinions and case. Holes in washer assist lubrication of side gears. These washers should be checked and if appreciably worn, replaced.

Differential case halves are held together with special bolts, nuts of which are wired together after installation.

DRIVE PINION

Drive pinion, mounted at an angle in differential carrier, is straddle mounted. Outer tapered roller bearings are contained in a cage, and are adjusted on shaft, by means of locking nuts and washers. Shims between cage and carrier are used for adjusting tooth contact and gear backlash.

Inner roller bearing is pressed on stub end of shaft and held in position with thrust washer and retaining screw.

AXLE SHAFTS

Axle shafts are full floating type. Drive flanges at outer ends have external teeth which mesh with similar internal teeth on hub drive ring. Drive ring is doweled to hub and held in place together with plate cover with ten hub stud nuts.

Spring loaded oil seals, installed in housing at inner end of each shaft prevents oil leakage into axle tubes. Gaskets at outer end between drive plate, drive ring and plate cover exclude dirt and water. See Fig. 2.

REMOVAL AND INSTALLATION

Service operations necessary for complete overhaul are given in succeeding paragraphs. The sequence, however, may be changed to suit service facilities and conditions.

Engine axle assembly can be withdrawn from chassis if desired. However, this is unnecessary except for replacement of housing or some other major service operation.

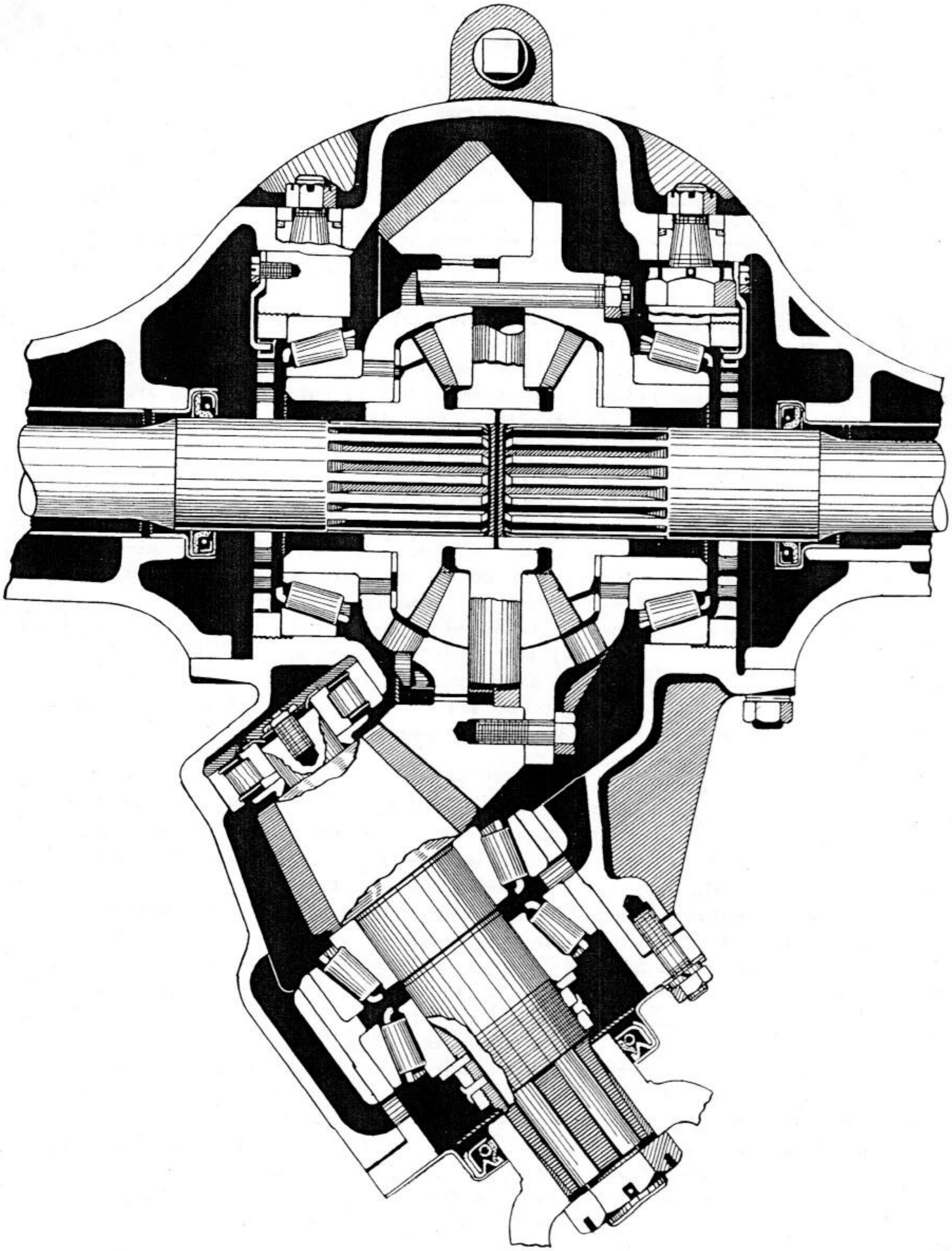


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Fig. 1 Sectional View of Differential Drive Unit Assembly

REMOVING AXLE ASSEMBLY

1. Block up rear end of chassis sufficiently to take weight from springs.
2. Remove spring shackle and pin nuts (see "Springs").
3. Disconnect propeller shaft flange at transmission and remove rear universal and slip joint sleeve.
4. Disconnect air lines so that axle can be removed from coach.
5. Withdraw entire assembly from coach.

REMOVING AXLE SHAFTS

1. Remove outer drive plate cover.
2. Insert 1/2" - 13 cap screw in tapped hole in axle flange. Screw should be long enough to pull axle flange free from teeth on drive plate. Withdraw axle from sleeve. NOTE: If necessary to remove drive plate, allow shaft to remain in place. There are three tapped holes in drive plate for pulling. Use regular puller with pressure on axle shaft center. Puller screws should be 1/2" - 13.
3. Hub bearings should be removed at this time for inspection.

REMOVING DIFFERENTIAL CARRIER

1. Drain axle housing bowl.
2. Remove propeller shaft and yoke from end of pinion shaft.
3. Remove the four nuts, washers, gaskets, and tapered dowels, at front of housing bowl (toward front of coach).
4. Remove 12 housing and carrier stud nuts and withdraw assembly from housing bowl.

DISASSEMBLING DIFFERENTIAL

1. Remove nuts from differential side bearing cap studs, and lift off caps.
2. Lift out differential and ring gear assembly.
3. Before disassembling differential case, see that both halves are marked so that they can be reassembled in same relative position.
4. Inspect pinion gears, side gears, and ring gear for scores, checks and nicks. Replace parts if worn.
5. Inspect pinion and side gear thrust washers and renew if appreciably worn. It is recommended that these thrust washers be renewed whenever differential is overhauled, although they may not be worn down perceptibly.

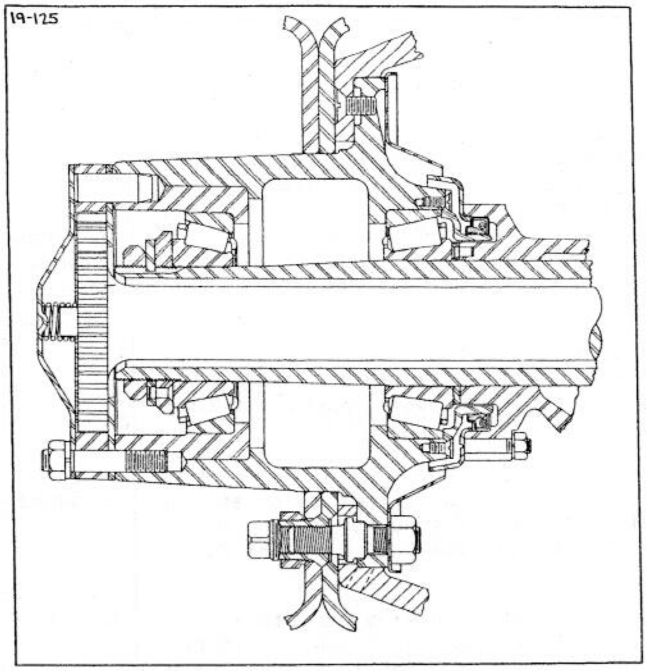


Fig. 2 Axle Shaft Outer End Construction
Drive is Through Gear Teeth and Hub

6. Clean and inspect differential side bearings. If races and bearings are scored, replace with new parts.

DISASSEMBLING PINION SHAFT ASSEMBLY

1. After differential has been withdrawn from carrier, remove driving yoke, outer bearing cover and oil seal assembly.
2. Remove pinion shaft outer and inner bearing nuts and washers.
3. Mark relative position of cage and carrier housing. Cage must be installed in housing so that oil holes in cage register with those in housing. With a puller, withdraw bearing cage and bearings. Retain bearing cage shims.
4. After pinion shaft has been withdrawn through outer end of housing, remove inner bearing retaining screw and inner bearing.
5. Clean and inspect bearings and pinion. Pinion and bevel gear should be replaced in matched set.

ASSEMBLING DIFFERENTIAL

1. If ring gear has been removed from case, or if gear set is renewed, check face on flanged half of differential case for runout. Case must be bolted together, and

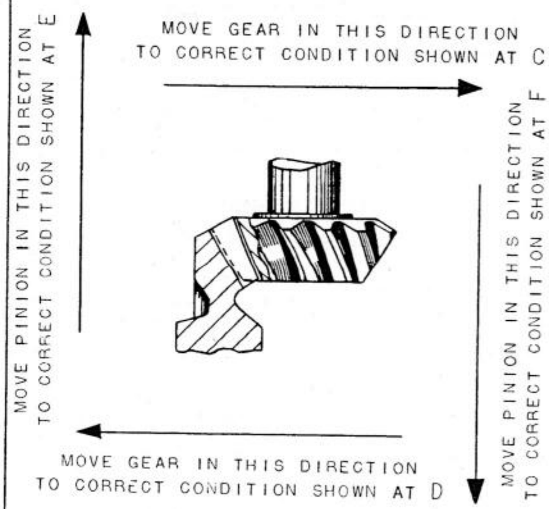
INSTRUCTIONS

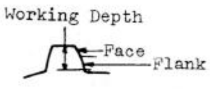
1-INSTALL PINION WITH PINION BEARINGS ADJUSTED FOR PROPER END-PLAY. INSTALL DIFFERENTIAL ASSEMBLY SO THAT WITH BEARINGS PROPERLY ADJUSTED THERE WILL BE SUFFICIENT BACKLASH TO PERMIT FINAL ADJUSTMENT OF PINION POSITION TO BRING HEELS OF TEETH FLUSH.

2-PAINT THREE OR FOUR TEETH OF BEVEL GEAR WITH RED LEAD OR PRUSSIAN BLUE AND ROTATE PINION UNTIL BEVEL GEAR MAKES COMPLETE REVOLUTION.

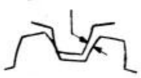
3-NOTE AREA OF TOOTH CONTACT WHICH SHOULD START AT TOE AND EXTEND ABOUT 80 PERCENT OF TOOTH LENGTH TOWARD HEEL, AS AT B.

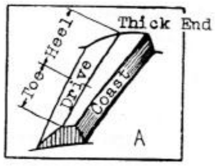
4-VARY POSITION OF PINION AND GEAR AS PER CHART UNTIL PROPER TOOTH CONTACT IS OBTAINED. BE SURE THAT SUFFICIENT BACKLASH HAS BEEN ALLOWED SO THAT GEAR CAN BE COMPLETELY REVOLVED WITHOUT ANY HIGHSPOTS BEING FELT.


MOVE GEAR IN THIS DIRECTION TO CORRECT CONDITION SHOWN AT C
MOVE PINION IN THIS DIRECTION TO CORRECT CONDITION SHOWN AT E
MOVE PINION IN THIS DIRECTION TO CORRECT CONDITION SHOWN AT F
MOVE GEAR IN THIS DIRECTION TO CORRECT CONDITION SHOWN AT D

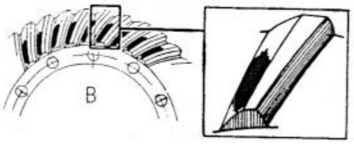


Backlash
See Specifications

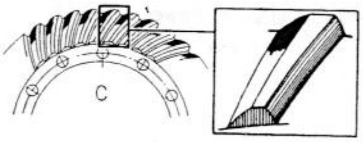




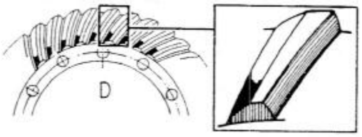
A-CHECK ADJUSTMENTS ON **DRIVE SIDE** OF TOOTH. COAST SIDE WILL THEN AUTOMATICALLY SHOW A DESIREABLE TOOTH CONTACT WHEN ADJUSTED CORRECTLY.



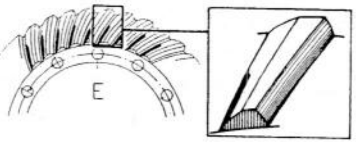
B-SHOWS CORRECT TOOTH CONTACT.



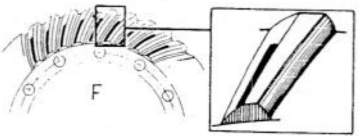
C-SHOWS SHORT CONTACT AT HEEL. TO CORRECT, MOVE GEAR TOWARD PINION. THEN MOVE PINION AWAY FROM GEAR TO AGAIN SECURE CORRECT BACKLASH.



D-SHOWS SHORT CONTACT AT TOE. TO CORRECT, MOVE GEAR AWAY FROM PINION. THEN MOVE PINION TOWARD GEAR TO AGAIN SECURE CORRECT BACKLASH.



E-SHOWS HEAVY CONTACT ON FLANK OR LOWER PORTION OF TOOTH. TO CORRECT, MOVE PINION AWAY FROM GEAR UNTIL CONTACT COMES TO FULL WORKING DEPTH OF GEAR TOOTH WITHOUT BREAKING CONTACT AT FLANK. THEN MOVE GEAR TOWARD PINION TO SECURE CORRECT BACKLASH.



F-SHOWS HEAVY CONTACT ON FACE OR UPPER PORTION OF TOOTH. TO CORRECT, MOVE PINION TOWARD GEAR UNTIL CONTACT COVERS FLANK OF TOOTH WITHOUT BREAKING CONTACT AT FACE. THEN MOVE GEAR AWAY FROM PINION TO SECURE CORRECT BACKLASH.

FIG. 3 CHART SHOWING METHOD OF SECURING PROPER BEVEL GEAR TOOTH CONTACT. IF CONTACT IS NOT CORRECT EXCESSIVE LOADS ARE CONCENTRATED ON SMALL TOOTH AREAS AND RAPID WEAR OR BREAKAGE WILL RESULT.

mounted if possible in lathe on side bearings. If cone centers are not available, make certain that hubs are positively centered in lathe. Run-out should not exceed .002" total indicator reading. Take reading on flange face to which ring gear is attached. If run-out is not appreciably over limits, take a light cut on flange face to true-up.

2. Assemble spider, pinions, side gears, and thrust washers into differential case.
3. With location marks in line on case halves bolt assembly together securely. Wire heads of bolt nuts together.

ASSEMBLING PINION SHAFT ASSEMBLY

1. Install straight roller bearing on forward end of pinion shaft drawing retaining screw up tight.
2. Assemble tapered roller bearings and cage to pinion shaft. Put inner lock washer in place and draw up inner adjusting nut tight to seat bearings. Then back off nut until shaft turns freely but will not spin. If nut is loose on threads, new nut should be used.
3. Install outer lock washer and lock nut, drawing nut up tight. Before bending lockwasher down over inner and outer nuts, check bearing adjustment again to be sure that adjustment was not changed by tightening of lock nut.
4. Before installing pinion, dip plain roller bearing in clean, new engine oil.
5. Install pinion and cage assembly, using original shims back of cage flange. Be sure oil holes in pinion bearing cage are in line with those in carrier to assure proper lubrication.

ADJUSTING DIFFEREITIAL GEARS

1. Install differential with side bearings and adjusting ring. When installing bearing caps in place, be careful not to damage threads on adjusters or supports. Turn stud nuts up tight and then back off just enough to permit adjusting nuts to turn.
2. Adjust side bearings so that differential has no side movement, yet can be rolled easily.
3. Adjust differential bearings and pinion cage position until backs of teeth of pinion and ring gear are flush with backlash as recommended under "Specifications". When moving differential, turn both adjusting rings exactly same amount to maintain proper bearing adjustment. Pinion bearing cage can be moved in or out by removing or adding shims under flange. When cage if finally installed be sure oil holes are in line.
4. Paint the teeth on ring gear with a mixutre of red lead powder and a few drops of light oil.
5. Turn gear a few revolutions in both directions. Examine tooth impression and then refer to chart on Fig. 3 which explains in detail methods used to obtain correct tooth contact. Remember pinion shaft is moved in either direction by removing or installing shims located between outer bearing cage and carrier housing. Cage must be removed with a puller. Shims are available in various thicknesses, as listed under "Specifications".
6. After tooth contact and backlash adjustments have been completed, tighten carrier stud nuts and install adjusting ring locks.

BACKLASH

Bevel gears are cut to have a definite amount of backlash which varies according to the pitch and operating conditions. This backlash is necessary for the safe and proper running of the gears. If gears are set too tightly they will be noisy, wear excessively, and possibly score on the tooth surfaces. It is strongly recommended that proper gauges be used for the correct setting of pinion and gears, and that gears then be set to the specified backlash as measured by a dial indicator.

INSTALLING DIFFERENTIAL CARRIER

1. Make certain that ring gear bolts and differential case bolt nuts are securely wired.
2. Install differential carrier in axle bowl (with new gasket between housing and case). Install bearing cap stud tapered dowels with gaskets, washers, and nuts. Make sure that gaskets in washers are in good condition.
3. Install and tighten housing and carrier stud nuts.

COMPLETING ASSEMBLY

1. Before axle shafts are installed, clean, adjust, and pack wheel bearings as directed in "Wheel" section.
2. Install drive rings, drive plates, and axle shafts. Three gaskets are used at flange end of each axle; namely, between drive ring and hub, between drive plate and drive ring, and between drive plate and plate cover. Make certain that small coil spring between plate cover and axle flange is located correctly on bosses on flange and cover.
3. Install universal joint flange and propeller shaft.
4. Reinstall entire assembly under chassis.
5. Refill to proper lever with correct lubricant.

LUBRICATION

A high grade lubricant of correct body and character, as specified in "Lubrication" section, must be used in differential. Recommendations are based upon practical experience and scientific knowledge of lubrication needs of differential. Considerable care should be taken when selecting a lubricant for this unit.

All oils will thicken as the result of constant high temperature. Oil recommended in less susceptible to thickening at normal operation temperatures and for reasonable mileage. Lubricant should be inspected, however, at regular intervals, and differential drained, flushed and refilled when oil shows signs of thickening.

"Lubrication" Chart specifies that differential should be drained and refilled at 15,000 mile intervals. However, check at least every 1,000 miles and if oil shows signs of thickening, axle housing should be drained, flushed and refilled regardless of mileage.

Oil should always be kept at proper level, determined by removing level and filler plug at front of axle bowl. See "Data" section at front of hood for capacity of differential.

SPECIFICATIONS

Type------------Full Floating Spiral Bevel
Drive---------Hotchkiss - Thru Rear Spring

DIFFERENTIAL

Number of Pinions-----------------------4
Bearings-------------------Tapered Roller
Gear Ratio--------------------3-7/12 to 1

AXLE SHAFTS

Diameter (Differential End)-2.300"-2.290"
Number of Splines----------------------16
Type Spline-----------------Tapered Tooth

DIFFERENTIAL

Bearing Adjustment -No Perceptible End Play
Gear and Pinion Backlash-------.008"-.012"
Gear Run-Out - Not Over-------------.005"
Case Run-Out - Not Over-------------.002"

CLEARANCE BETWEEN

Pinion and Spider-------------.003"-.007"
Side Gear and Spider----------.002"-.003"
Thrust Washer - Side Gear
New Limits--------------------.125"-.121"

PINION BEARINGS

Forward--------------------Tapered Roller
Rear----------------------Straight Roller
Bearing Adjustment-No Perceptible End Play
Method of Adjustment----------------Shims
Shims Available---.005"-.010"-.020"-.030"

AXLE SHAFT

Out-of-True - Not Over--------------.005"
Run-Out - Not Over------------------1/32"

Body

Illustrations and Descriptions in This Group Apply to Following Subjects:

Body Structure
Body Compartments
Door and Mechanism
Windows
Windshield and Wiper
Signs and License Holders
Seat Mechanism
Lubrication Points

Instructions Applying to Related Parts of Body Will Be Found in Following Groups:

Name	Group No.
Lighting Equipment	7L.0001
Heating & Air Conditioning	Air Conditioning Manual

The body proper and under structure are constructed of steel and aluminum and are built as a unit. Aluminum parts are fabricated from strong aluminum alloy castings and sheets. Underframing, integral with body, is entirely open, with controls easily accessible and free from road dirt, etc. Body parts can be repaired and replaced by competent craftsmen with proper tools and equipment.

It is extremely important that only genuine body parts furnished from the factory be used as replacement. These genuine parts are precision built and are finished for replacement with the minimum effort and expense.

The Aluminum Company of America will furnish upon request booklets entitled "The Riveting of Aluminum", and "The Welding of Aluminum". The booklets explain in detail procedure necessary to repair and replace aluminum parts.

TREATMENT OF ALUMINUM

When aluminum parts are repainted or new unfinished parts are installed, following procedures are recommended.

REPAINTING ALUMINUM PARTS

1. Completely remove old paint by use of organic solvents - do not use alkaline paint removers. If primer is very difficult to remove, and if there is no evidence of metal corrosion, old primer may be left on.
2. Wire-brush or sand metal surfaces thoroughly to remove corrosion products.
3. Swab the cleaned metal surfaces thoroughly with warm 5% potassium dichromate solution (two ounces of potassium dichromate in one quart of water). Allow parts to dry.
4. Apply primer -- preferably by spraying; air dry. Apply primer very thin until it is greenish in color. If primer is applied too thick, it assumes a yellow color. Use suitable zinc chromate primer obtained from a reputable paint manufacturer. Dupont #64-1016 or Arco #214-30089 may be used.
5. Apply finish coats.

   (a) For understructure or other parts not requiring color, apply two coats of a good clear air-drying lacquer, made by adding one part of Ducco or Toluol to five parts of clear air-drying TC 147 or TC 109 Dulux, and mixing two pounds of Standard Albron (aluminum) paste with each gallon of the thinned lacquer.

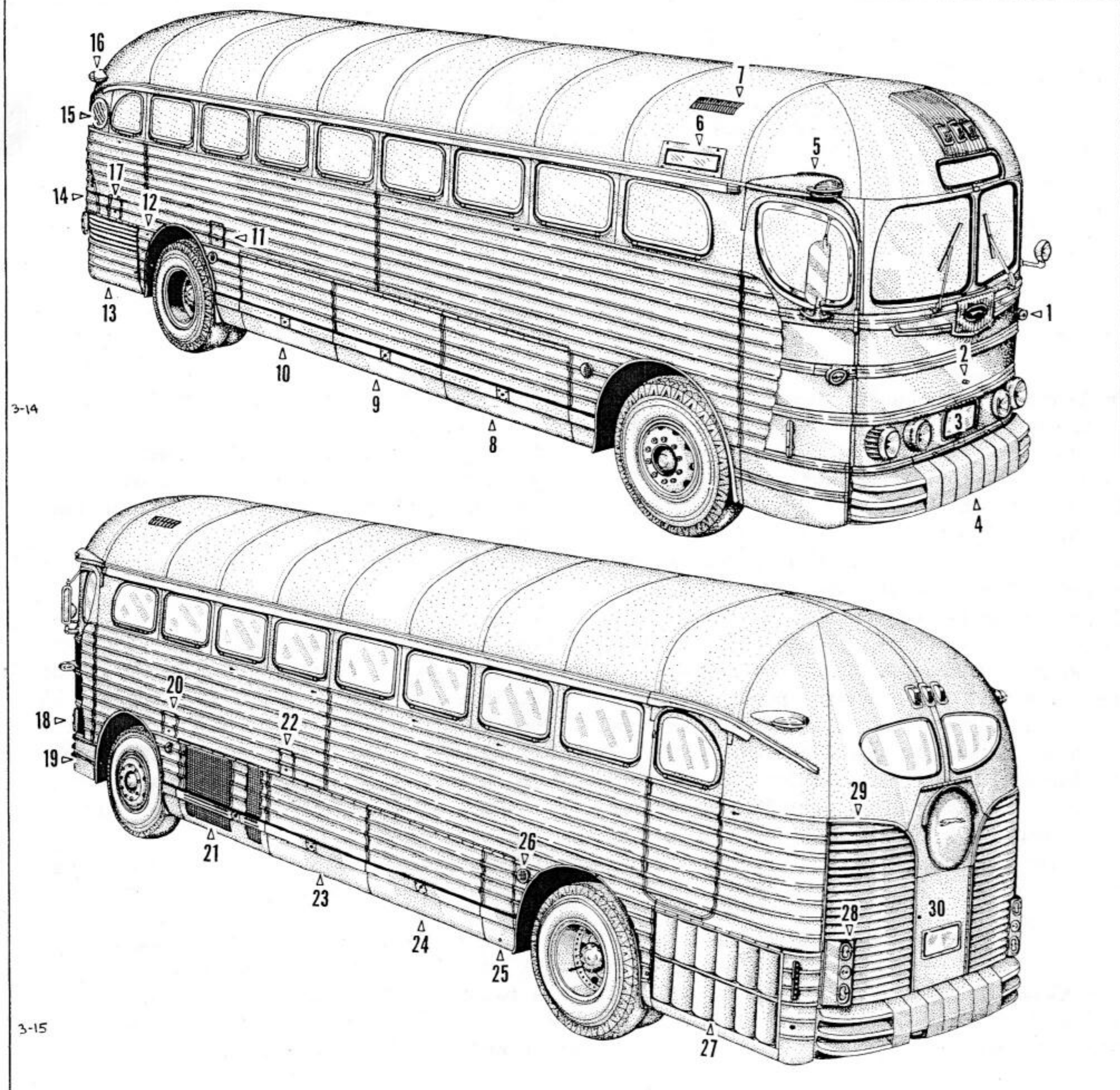
   (b) To exposed body parts, apply air-drying surfaces and color coats in accordance with standard practice.

NOTE: The above procedure may be applied to steel and iron parts also, except that alkaline paint removers may be used on iron and steel provided all traces of that paint remover be washed off before priming.

NEW PARTS

When installing new aluminum parts, or new parts which contact with aluminum in assembly, succeeding procedures should be followed:

1. Remove from vehicle old parts to be replaced.
2. Treat adjacent parts remaining in chassis or body according to instructions in paragraphs 1, 2, 3 and 4 under "Repainting Aluminum Parts".
3. Assemble new parts. If bolts are used, dip in primer before installing. Allow to dry.



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LEGEND

Item	Name	Item	Name	Item	Name
1	Fr.Directional Lights	11	Main Fuel Tank Filler	21	Air Condition Compartment
2	Ent. Door Emerg. Opener	12	Fuel Tank Valve	22	Air Cond. Rad. Water Filler
3	License Plate Compt.	13	Trans.Inspection Door	23	L.H. Front Bag. Compartment
4	Spare Tire Compartment	14	Control Box Compartment	24	L.H. Rear Bag. Compartment
5	Markers (Frt.)	15	Fuel System Air Intake	25	Battery Compartment
6	Side Dest. Sign	16	Rear Markers	26	Rear Reflector
7	Air Intake	17	Aux. Fuel Tank Filler	27	Radiator Shutter Door
8	R.H.Frt.Bag.Compt.	18	Tool Compartment	28	Stop, Tail, Direct. Lights
9	R.H.Center Bag. Compt.	19	Horn Compartment	29	Left Engine Compt. Door
10	R.H.Rear Bag. Compt.	20	Fuel Tank Filler(Air Cond.)	30	Rear License Compartment Door

Fig. 1 Exterior Body Locations

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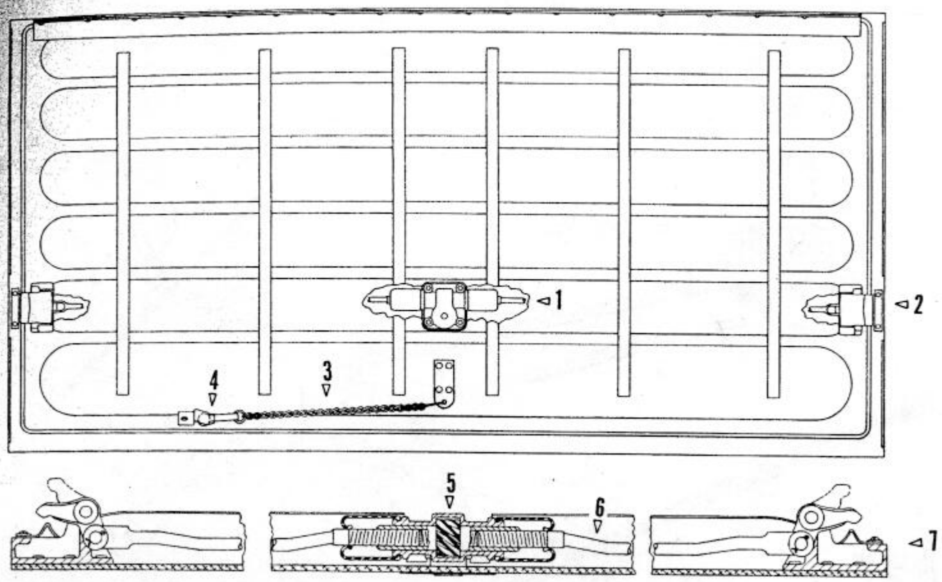

1. Lock
2. Latch
3. Chain
4. Chain Clip
5. Latch Rod Gear
6. Latch Rod
7. Latch Bracket

Fig. 2 Baggage Compartment Door Construction

BODY COMPARTMENTS

Location of various body compartments accessible from exterior of coach are designated by numbers on Fig. 1. Various units are accessible through compartments. Accessibility and location of parts in the compartments are explained in the various groups of this book.

Interior compartments not designated on Fig. 1 are as follows:

INSTRUMENT PANEL COMPARTMENT (Back of Panel)

The left hand windshield wiper motor is accessible in this compartment, also connections to wiper air valve.

FIRE EXTINGUISHER COMPARTMENT

Located under center dash panel.

SAFETY EQUIPMENT COMPARTMENT

Located under extinguisher compartment and contains flare and flag kit and entrance door step light switch. Entrance door and retracting rod mechanism is also accessible through this compartment.

GLOVE COMPARTMENT

A portion of right hand windshield wiper motor is accessible through this compartment.

EXTERIOR BODY MAINTENANCE

To avoid damaging the Alumilite finish on exteriors of coaches, it is recommended that only cleaners which conform with the specifications set up by Aluminum Company of America be used (copy of specifications obtainable upon request). Cleaners meeting specifications will be suitable for painted as well as Alumilite exterior coach surfaces.

It is generally advisable to wash coach thoroughly with fresh water before applying cleaner, and a water rinse should be given after cleaner has been applied. Proper use of cleaners is fully as important as their selection; therefore, it is essential that cleaners be applied strictly in accordance with instructions of the cleaner manufacturers, both as to strength of solution and washing procedure.

At regular intervals, usually not more than

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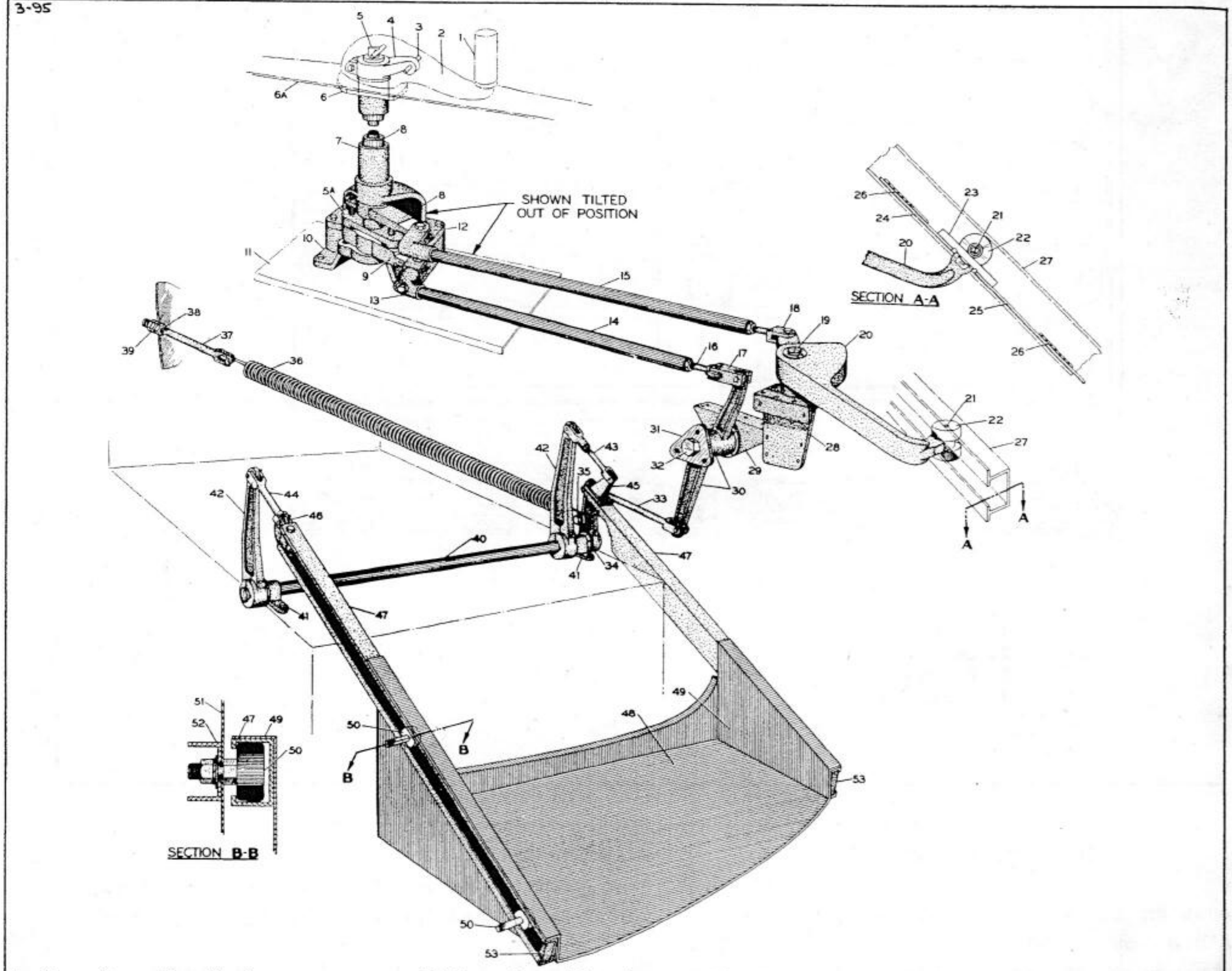

1. Door Operating Knob
2. Door Operating Handle
3. Door Control Handle Fulcrum Pin
4. Door Control Handle Level
5. Retracting Step Lift Rod
5A. Door and Step Control Interlock Assembly
6. Door Control Shaft Bracket
6A. Windshield Ledge
7. Door and Step Control Rod Housing Tube Assembly
8. Door Control Tube and Lever Assembly
9. Step Control Lever Assembly
10. Door and Step Control Bracket
11. Front Compartment Floor Sheet
12. Door Operating Rod Yoke
13. Step Operating Rod Yoke Assembly
14. Step Operating Rod
15. Door Operating Rod
16. Step Control Tube Screw Eye
17. Step Control Yoke
18. Door Operating Lever Yoke
19. Door Operating Lever Shaft
20. Door Operating Lever
21. Door Operating Lever Roller Pin
22. Door Operating Lever Roller Assembly
23. Door Operating Lever Seal Shoe Assembly
24. Door Operating Lever Front Seal
25. Door Operating Lever Rear Seal
26. Door Operating Lever Seal Guide
27. Door Roller Track
28. Door Operating Lever Assembly
29. Step Control Bell Crank Shaft Front Support Bracket
30. Step Control Bell Crank
31. Step Control Bell Crank Shaft Rear Support Bracket
32. Step Control Bell Crank Through Bolt
33. Step Control Bell Crank to Cross Shaft Lever Rod Assy.
34. Step Control Cross Shaft Short Lever
35. Retracting Step Balancing Spring Roller Assembly
36. Retracting Step Balancing Spring
37. Retracting Spring Eye Bolt
38. Retracting Spring Eye Bolt Adjusting Nut
39. Retracting Spring Eye Bolt Lock Nut
40. Retracting Step Operating Cross Shaft
41. Cross Shaft Bearing
42. Step Control Front Operating Lever Rod Assembly
43. Retracting Step Front Operating Lever Rod Assembly
44. Retracting Step Rear Operating Lever Rod Assembly
45. Retracting Step Front Track
46. Retracting Step Rear Track Operating Bracket
47. Retracting Step Roller Track
48. Retracting Step Bottom Plate
49. Retracting Step Side Plate
50. Retracting Step Roller and Bearing Assembly
51. Front Under Frame Bulkhead
52. Retracting Step Roller Reinforcement
53. Retracting Step Roller Track Stop

Fig. 3 Retracting Step Mechanism

30 days, coach exteriors should be well waxed. Intervals between waxing should be sufficiently short to assure protection of the finish at all times by a continuous coat of wax. Any good coach body wax is satisfactory for Alumilite as well as painted surfaces. Wax should be applied, immediately after coach has been cleaned, by spraying or other means, and should be rubbed down either with a lamb's wool polishing wheel or by hand.

INTERIOR BODY MAINTENANCE

CLEANING LIGHT FIXTURE GLASS

Semi-frosted glass may be cleaned by pouring a small amount of commercial Muriatic (Hydrochloric) acid on glass and rubbing gently with clean cloth. Glass must be removed from coach for cleaning as attack of this strong acid on adjacent parts might be severe. Persons cleaning these parts should wear rubber gloves, and the parts should be rinsed thoroughly in water after cleaning.

PAINT FINISH

1. Clean surface finish with rag dampened in gasoline. Gasoline will cut grease.
2. Rub with polishing compound.
3. Rub with clean rag until original finish is restored.

CLEANING RUBBER

Use soap and water for cleaning rubber. Do not use gasoline, as this has a tendency to blister rubber.

CLEANING METAL

Use paint thinner or any good metal polishing compound for metal surfaces.

CLEANING WINDOW GLASS

1. Apply cleaning solution.
2. Rub with cloth dampened with water.
3. Rub with clean cheese cloth until dry. Cleaning agent may contain soap but should not attack paint.

ENTRANCE DOOR

Single passenger entrance and exit door is of aluminum frame and panels and is operated manually from driver's seat, independently or in conjunction with retracting step. Refer to Fig. 3.

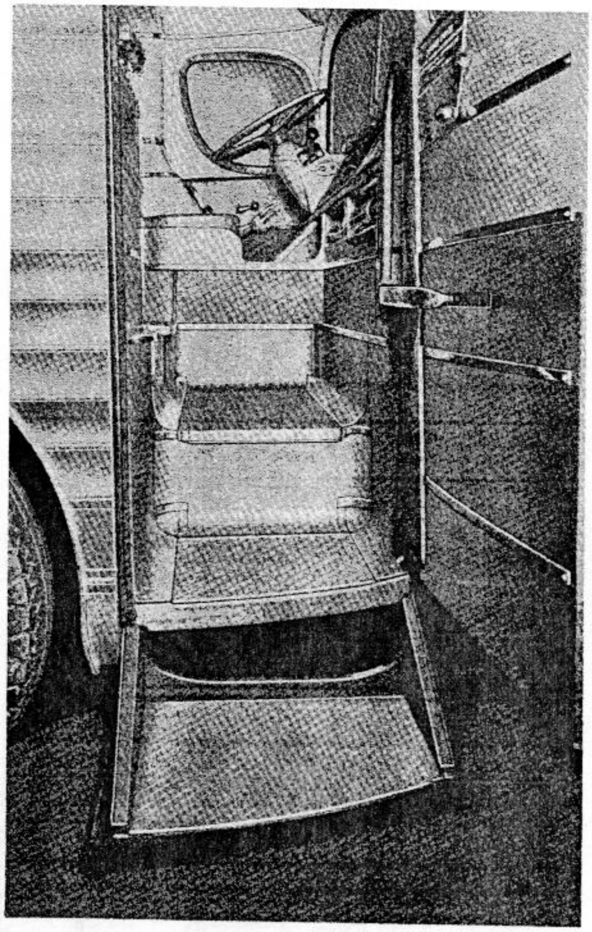

Fig. 4 Front Entrance Door

Door control and retracting step mechanism provides independent operation of door and retracting step. Retracting step moves on hard rubber rollers (50) operating in step roller tracks (47).

To open and close door only, independent of retracting step, rotate door operating knob (1).

Rotation of door operating knob (1) turns door control tube and lever assembly (8), thereby actuating door operating rod (15) and yoke (12), which fastener actuates door operating lever (20), forcing door open or closed.

For simultaneous operation of door and retracting step, press down on door operating knob (1) and rotate. Downward pressure on knob (1) causes door operating handle (2) to rotate vertically about fulcrum pin (3), raising retracting step lift rod (5) and door and step control interlock assembly (5A), engag-

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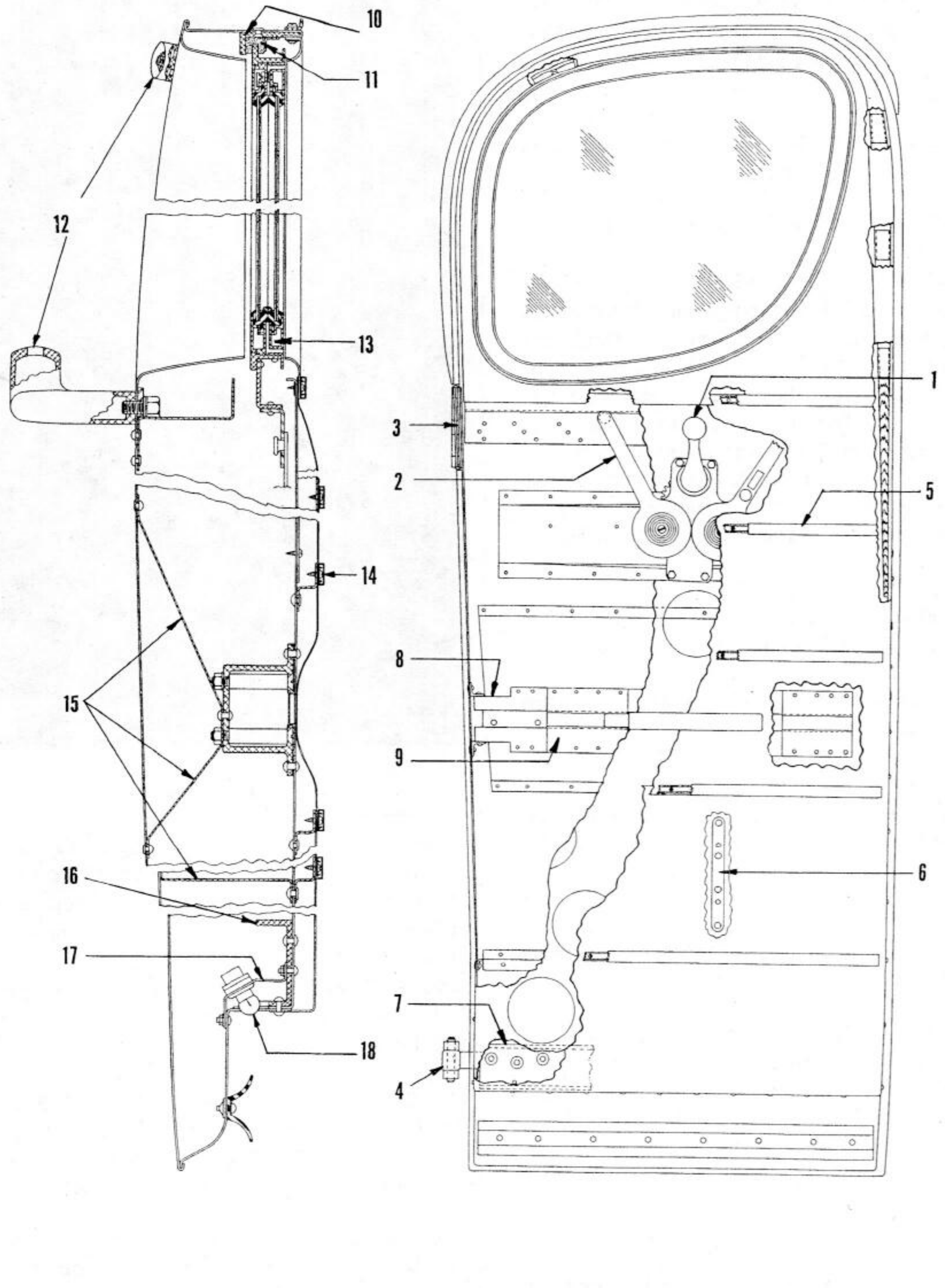


1. Window Regulator Handle
2. Window Regulator Assembly
3. Upper Hinge
4. Lower Hinge
5. Moulding
6. Reflector Spacer (Outside of Door)
7. Channel
8. Door Roller Track
9. Guide
10. Window Frame
11. Window Channel
12. Mirror Brackets
13. Sash Assembly
14. Moulding Retainer
15. Reinforcement Panels
16. Channel
17. Bracket
18. Step Light Bulb

Fig. 5 Front Entrance Door Construction

ing pins into holes on door control tube and lever assembly (8). Step control lever assembly (9) and door control tube and lever assembly (8) are now locked together by pins through interlock assembly (5A).

Rotation of door operating knob when these members are locked together causes door to open or close as before and also operates step by actuating step operating rod (14), screw eye (16) and yoke (17), thereby rotating step control bell crank (30) which turns cross shaft (40) by short lever rod (33) and short lever (34). Cross shaft (40) in turn, moves step up or down on rollers (50) through cross shaft long levers (42) and operating lever rods (43 and 44). Weight of retracting step is balanced by spring (36).

Door or door and retracting step are automatically locked in position when handle is placed in extreme right or left position.

When assembling door and step control interlock assembly (5A), make sure lower pins engage step control lever plate (9), or retracting step will fall out when controls are operated.

ADJUSTMENTS

Adjustments are provided at right of door and step operating rods (14 and 15) whereby lengths of these rods may be varied so as to obtain synchronous operation of door and step (open and close at same time). Right end of door operating rod (15) is accessible through right hand fog light opening. Right end of step operating rod (14) is accessible through safety equipment compartment door, under flare kit.

Tension of balancing spring (36) is varied by nuts (37 and 38) accessible through left hand fog light door.

ENTRANCE DOOR OUTSIDE LOCK RELEASE BUTTON

Door mechanism is provided with an emergency door lock release button located outside, above license plate. Pressing door lock release button forces lock plate past center and releases automatic door lock.

FRONT ENTRANCE LIGHTS

Front door step one bulb light is located at bottom of door under trim panel and is accessible through hand hole. See Fig. 5.

Step well one bulb light is located at lower rear of step well compartment under built-in protecting shield.

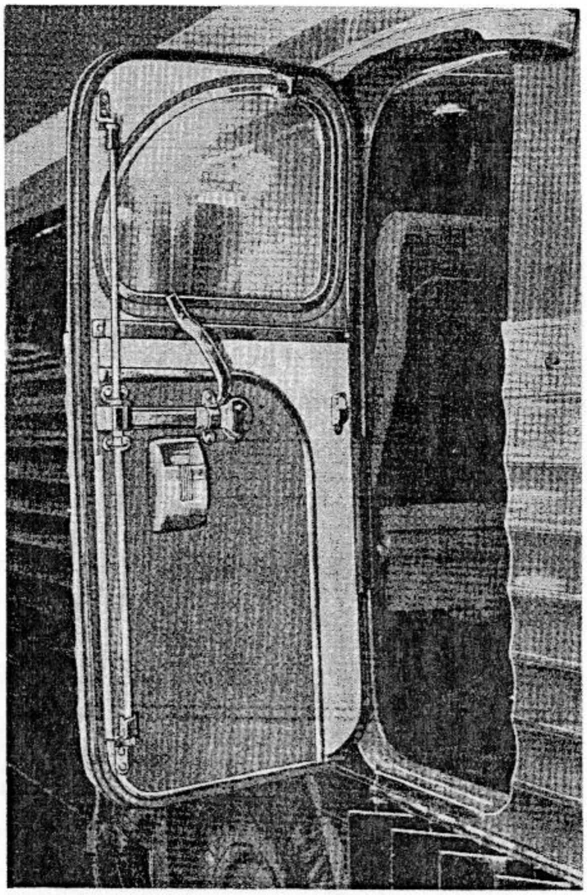


Fig. 6 Emergency Door

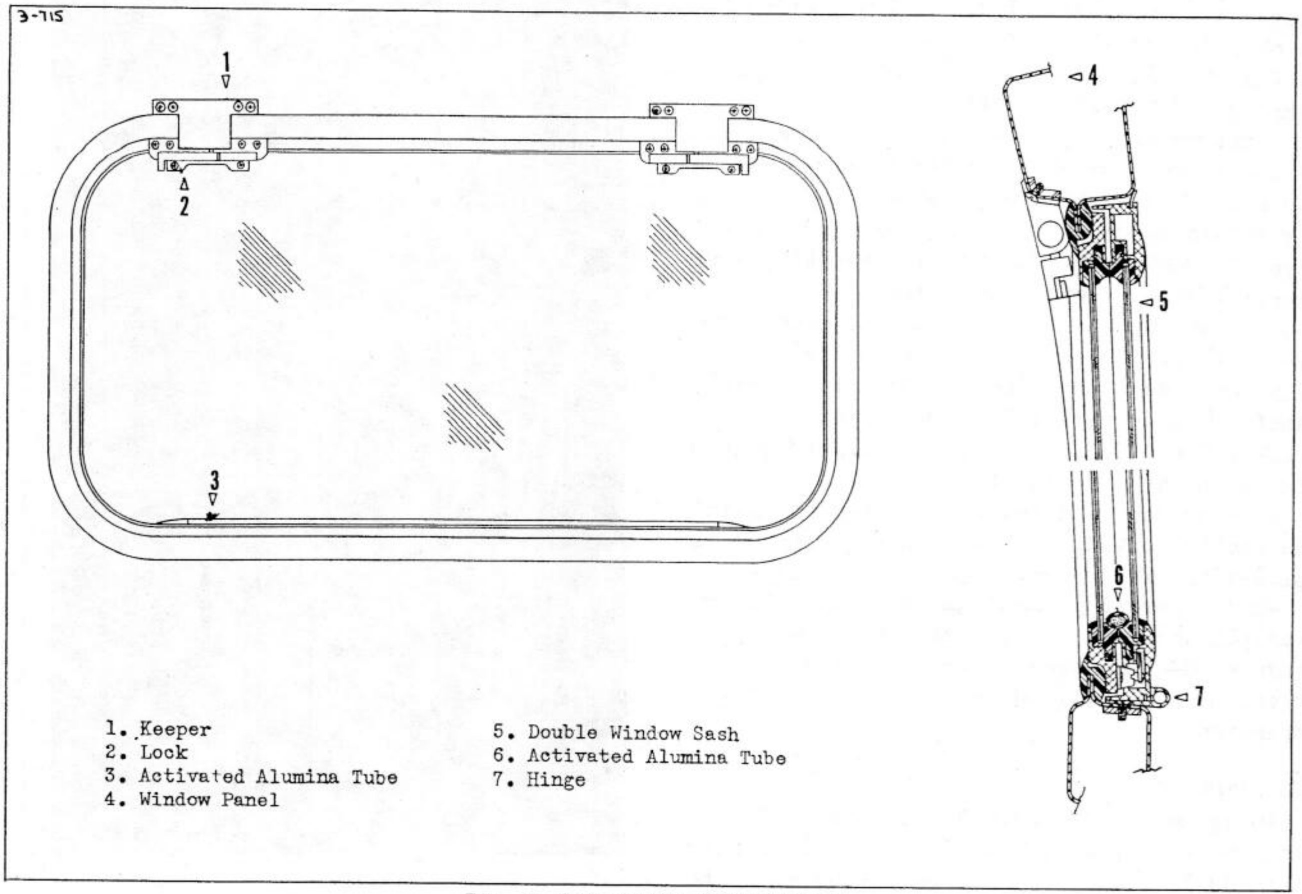
Front door step and step well lights are operated by "Step" button at light switch panel. These two lights are also automatically turned off when door is closed by means of switch installed in safety equipment compartment and actuated by door operating rod.

EMERGENCY DOOR

The sedan type safety door is located on left hand side of coach, immediately back of rear wheel. It is equipped with a manually operated locking lever mechanism which actuates emergency door tell-tale light switch. See Fig. 6.

TELL-TALE LIGHT SWITCH

Emergency door tell-tale light switches are installed on door lock lever catch and at lower rear corner of door frame. Door lock lever



1. Keeper
2. Lock
3. Activated Alumina Tube
4. Window Panel
5. Double Window Sash
6. Activated Alumina Tube
7. Hinge

Fig. 7 Side Window Construction

catch switch operates tell-tale light on instrument panel when door is unlocked. Lower rear corner switch operates tell-tale light when door is locked but open. Some models are equipped with door lock lever catch switch only.

DOOR GLASS

Front and emergency door upper panels are glazed with double safety sheet glass containing activated aluminum tube at bottom for dehydrating air left in at time of assembly. Removal and installation of broken glass is accomplished by following same procedure as for side coach windows. See "Windows".

SIDE WINDOWS

The double glazed sash units in these windows are specially designed and manufactured for air conditioned operation, with dehydrating compound (Activated Alumina) tube at bottom, between sections. The windows are attached to body by a hinge along bottom of window opening and are held in at top by two locks and keepers. Fig. 8.

In case air conditioning fails, these locks may, for ventilation purposes, be operated so as to allow window to swing partially open at top outwardly for a space of about 1-1/2" and to then hold window securely in this position.

Locks also may be so operated as to allow the sash to be turned outwardly completely out of the opening and hang down along the side of the body, if, for some reason, this should be necessary.

A further important feature is that, in an emergency, the locks will automatically release and allow window to be completely opened by a sudden, strong application of pressure, applied to the upper portion of the unit, from the inside.

TO OPEN FOR VENTILATION

1. Turn the outer of the two screws on each of the locks a quarter turn outwardly; i.e., to the right on right hand lock and to the left on the left hand lock. This

releases the adjustable latch levers so they may be operated.

2. Draw in both of these levers, at the same time turning them inwardly through an arc of 90° until they are stopped by the stop blocks, in which position they will be at right angles to the window.
3. Push window out at the top until the holding pins protruding downward from the keepers are brought into snug frictional engagement with the recess in the end of the latch levers and held in this position by the latch springs.

TO CLOSE AND LOCK WINDOW

1. Pull latch levers out of engagement and draw them steadily inward while swinging them outwardly into their original locked position. This produces a cam action on the holding pins and draws the unit tightly into the opening to effect a weather seal.
2. The locking is completed by turning outer screws inwardly for a quarter turn so as to lock latch levers. It is important that this always be properly done when air conditioning system is in operation to prevent opening.

TO COMPLETELY OPEN WINDOWS

1. Turn both screws in both locks a quarter turn to release latch levers and stop blocks. Stop blocks will automatically spring out to a new stop position.
2. Swing latch levers inwardly until stopped by stop blocks in the new position. In this position, cut away sides of latch levers will clear holding pins, and unit is free to be opened.
3. Slowly move window out of opening, and as it swings out on its hinge, be extremely careful to retain control of its motion so that it does not get away and drop forcibly against the coach side with attending damage and glass breakage.

TO OPEN IN AN EMERGENCY

1. By applying a sudden, strong impact to the upper portion of window, holding pin cam springs will be overcome and window automatically ejected out of its opening whether completely locked or partially open for ventilation.
2. CAUTION: This naturally must only be done in a real emergency because of the obvious danger and damage to coach body and window that will ensue.

REPLACING GLASS

Complete sash and glass assemblies are furnished by the manufacturer of these double window installations. However, a broken glass can be replaced as follows:

1. Remove window from coach.
2. Remove rubber seal, marking seal perforations on sash in order to install in same position.
3. Remove broken glass.
4. Clean new glass thoroughly.
5. Install glass.
6. Install rubber seal. Press with flat tool to make sure rubber seal lip fits tight around glass. Use glycerine dissolved in water, or similar solution to facilitate installation of rubber. Glycerine does not attack paint. Be sure marks correspond. Work rubber seal around sash until evenly distributed.

Outside glass unit contains activated alumina tube. To replace glass, first remove activated alumina tube, proceed as outlined above, and reinstall tube before new glass is replaced. Consult "Refilling and Installing Activated Alumina Tube", in this same group.

ACTIVATED ALUMINA

Aluminum trihydrate, rendered highly porous and absorptive, yields a product called "Activated Alumina".

Activated Alumina is a granular adsorbent (essentially aluminum oxide) capable of adsorbing substantially 100 per cent of the moisture from gases or vapors, and is furnished in several grades.

Grade E (Mesh 8-14) Activated Alumina used in this coach is indigo in color when fully active or reactivated, and during adsorption of moisture changes progressively through pink to white.

The purpose of this dehydrating material as used in the double glass windows is to adsorb the moisture from the air left between glass sheets at the time window is glazed, thus keeping air dry for better insulation against prevailing outside temperatures, and thereby increasing the efficiency of the air conditioning system.

Activated Alumina or any other dehydrating compound deteriorates readily when exposed to moist air. Therefore, a tight, leakproof seal between glass sections is of utmost importance. This leakproof seal between glass sections is obtained by means of spring lock holding screws. Pressure on spring lock screws provides tight seal.

REACTIVATING ACTIVATED ALUMINUM

When Activated Alumina ceases to be effective for the adsorption of moisture, it can be revived by the application of heat to vaporize the absorbed water.

Reactivation, or desorption, is carried out generally at temperatures between 350° and 600° F. Part of the water is driven off at temperatures as low as the boiling point of water, but a temperature of at least 350° F. is required for complete reactivation. At higher temperatures, less time is required. Temperatures above 600°F. permanently impair the adsorptive properties of Activated Alumina. After reactivation, Activated Alumina is comparable in every way to the original product.

Activated Alumina must be purchased and kept in moisture proof containers. Standard size containers are as follows:

1 lb., 15 lbs., 25 lbs., and 50 lbs., metal cans. 100 lbs., and 325 lbs., steel drums.

REFILLING ACTIVATED ALUMINA TUBE

1. Remove tube from window sash.
2. Remove anchor tip at one end.
3. Cover tube perforations with tape to prevent moisture of air from reaching interior of tube.
4. Insert filling cup at open end.
5. Fill with Activated Alumina crystals.
6. Insert anchor tip after applying rubber cement to cover end.

INSTALLING ACTIVATED ALUMINA TUBE

1. Clean inside glass section thoroughly for quick installation.
2. Nail tube rubber anchors to outside window section, pressing hard on nail with short stick.
3. Remove tape from Activated Alumina tube holes.
4. Assemble two side window sections by pressing on spring lock screws and turning to right. Do not touch inside of glass.

REAR WINDOWS

Rear windows are of the double glass type containing activated alumina tube, but individual glass installation and removal is accomplished in the same manner as for windshield.

Activated alumina tube is bent to conform with shape of window and its installation is made as for side window dehydrating compound tube.

DRIVER'S WINDOW

The driver's window is of the double glass section type, sliding down vertically on guides for either signalling or ventilation and is operated by driver's window regulator handle at left of driver. Driver's window opening is provided with vertical drain pipe reaching through horn compartment at bottom of coach. Both glass sections are of the same construction as the side windows and glazing is accomplished in same manner. Inner section, however, can be taken out without removing entire assembly.

FRONT DESTINATION SIGN WINDOW

The front destination sign is of the built-in illuminated type with large glass opening for white letters on black background. Signs are changed back and forth in sign compartment by rotating knurled knob at left of compartment. Knurled knob operates gear mechanism rotating roller shaft. Three light bulbs provide ample sign illumination and are turned on by switch marked "Sign" in light switch panel. Bulbs are readily accessible for replacement through interior destination sign compartment door. Glass is removed and installed in the same manner as for windshield, with proper rubber channel and insert.

LICENSE HOLDERS

FRONT

The three plate license holder is accessible through front license compartment glass door, which is opened with door lock key. Plate holders are changed manually.

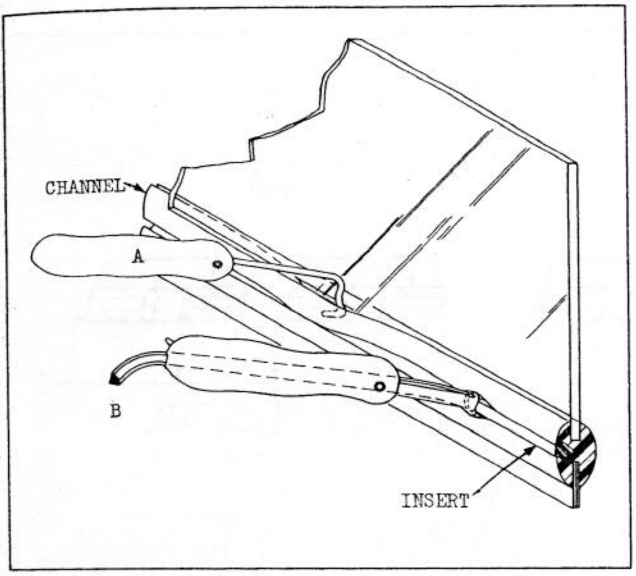


Fig. 8 Method of Installing Glass Inserts

REAR

Rear six plate license holder is accessible by opening license holder frame, back of engine compartment center door.

To change plates:

1. Open engine compartment center door with lock key.
2. Loosen back of license holder frame with lock key.
3. Lift rear section of holder frame.
4. Rotate upper knurled screw knob until desired license plate slips into position. Plates are attached to sprocket chain rotating on sprocket wheels installed at upper and lower ends of license holder frame. Two light bulbs are readily accessible for replacement, at bottom of license holder compartment.

For electrical connections and protecting fuses on all above units refer to "Electrical" group of this book. Glass is removed and installed in same manner as for windshield, using proper rubber channel and insert.

LICENSE PLATE WINDOWS

License plate windows are glazed with safety sheet glass set in rubber. Removal and installation of glass is accomplished by following the same procedure as for windshield, with proper rubber channel and inserts.

WINDSHIELD

The two-piece type windshield is glazed with heavy safety glass set in rubber seal channels as shown in Fig. 8.

WINDSHIELD SEAL AND GLASS INSTALLATION

Installation of windshield glass rubber seal and glass is made in following manner:

1. Apply cement around windshield flange and on rubber seal flange groove.
2. Install glass rubber seal on windshield opening flange. Push into position in corners. Cut off rubber seal allowing (1/2" in 50") overlap, rubber cement ends, and butt into position.
3. New glass must be cut to provide clearance between glass and rubber as follows: 1/32" on bottom, 3/32" on top and 1/10"

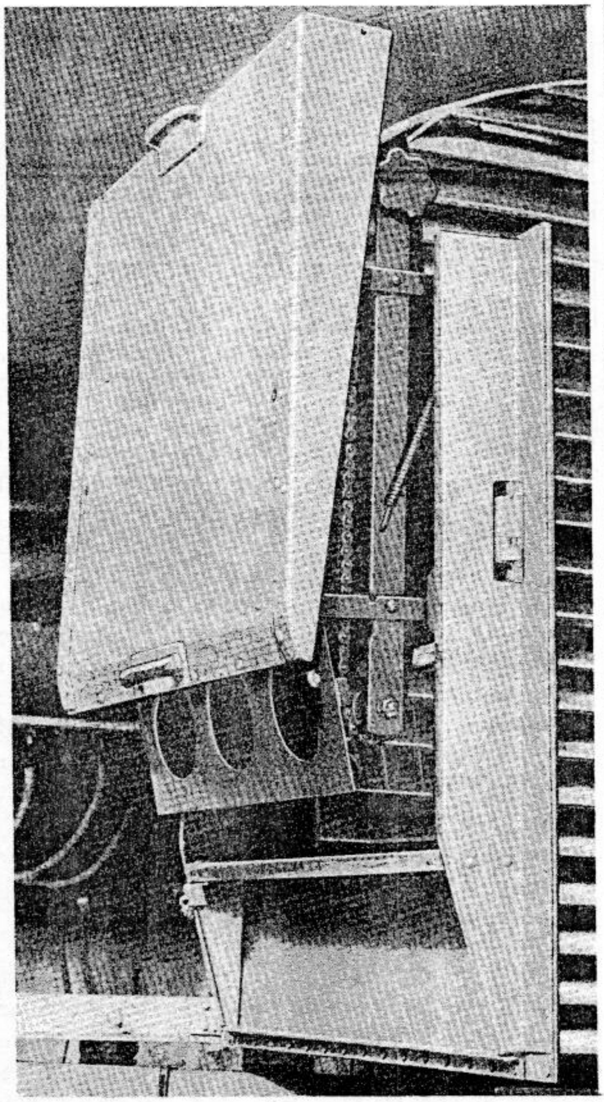
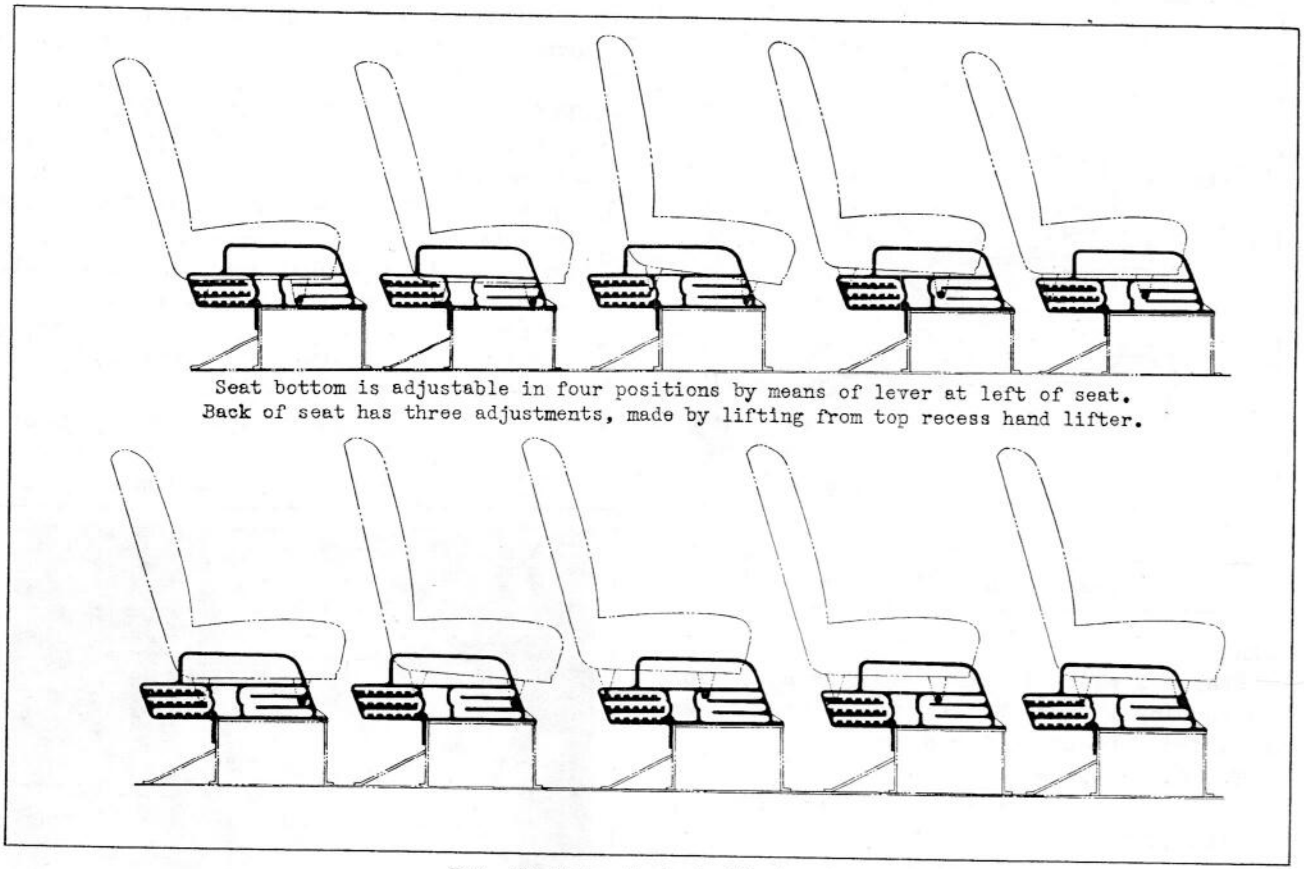


Fig. 9 Rear License Plate Holders



Seat bottom is adjustable in four positions by means of lever at left of seat.
Back of seat has three adjustments, made by lifting from top recess hand lifter.

Fig. 10 Driver's Seat Adjustments

on side and center posts.

4. Install glass in groove with tool "A". See Fig. 8. Apply end of tool in seal groove and by moving tool along edge of glass, the upper lip of rubber seal will be forced into position over glass.
5. Install one end of proper insert through handle and head of tool "B", starting opposite to rubber seal joint, and using hitching motion with tool to prevent excessive elongation of insert. Cut off insert with allowance for crowding and force butting ends tight into groove with screw driver.
6. Clean cement thoroughly around glass and windshield opening.

WINDSHIELD AIR PRESSURE WIPER MOTOR

The pressure wiper requires very little attention and will give long service with ordinary care. Most failures are often traceable to unnecessary forcing of wiper arm against pressure and past the normal stroke position. Undue forcing of wiper arm puts a strain on the valve mechanism and may result in damage. Refer to "Air Line Diagram" in "Brake" group for wiper connections.

The first requisite to proper wiper operation is to keep air supply free from excess oil, water, dirt, grit or other foreign matter. A clean air supply insures against rust, gumming or premature wearing of piston or valve parts.

WINDSHIELD MOTOR AIR STRAINER

An air strainer filled with hair moss is provided in air line connection between air feed pipe and operating valves. See "Air Line Diagram" in "Brake" group. Air strainer is accessible through tool compartment door at front left corner of coach, and can be removed for cleaning.

LUBRICATION

To oil wiper motor it is only necessary to saturate, now and then, oil retainer felts which lie parallel to wiper shafts. The device should require no other extra lubrication. It is suggested, however, that when wiper is torn down for repairs, all parts be thoroughly greased before reassembly.

WINDSHIELD WIPER MOTOR REPAIR

For all internal repairs it is necessary to remove motor head assembly. If necessary to take motor apart, all parts should be carefully checked for wear and lubricated before reassembly. Worn parts should be replaced.

WINDSHIELD WIPER MOTOR LOCATION

Right hand windshield wiper motor is accessible through right hand glove compartment and center switch and fuse panel. Left hand windshield wiper motor is accessible through gauge panel and center switch and fuse panel.

WINDSHIELD WIPER MOTOR REMOVAL

Motor is attached to outside body panel by means of two screws.

To remove motor:

1. Remove center switch and fuse panel.
2. Remove instrument panel (right hand windshield motor is accessible through glove compartment).
3. Remove windshield arm and clamp assembly.
4. Remove windshield wiper motor to outside body panel holding nut, spacer and washer.
5. Disconnect all air lines.
6. Remove windshield wiper motor and support.

Windshield wiper motor control valves are located at left rear corner of instrument panel compartment. Operating buttons are located outside at left of instrument panel.

WINDSHIELD WIPER HANDLE

Windshield wiper is provided with manually operated handle located on top of instrument panel, and connected to motor and windshield wiper arm by means of a universal joint device. Handle is disconnected from shaft for continuous air operation of windshield wiper motor.

IN CASE OF TROUBLE

1. Check air line for plugged fittings, kinked tubing or leaks. Make sure that all connections are tight.
2. If air line is satisfactory, turn on wiper regulating valve to diagnose trouble as follows:

CONDITION	CAUSE
a. Wiper works slowly or uneven.	Shaft bind. Make sure that shaft is free and does not bind in hole.
b. Wiper runs slowly and without power.	Diaphragm leaks. Defective valve.
c. Wiper runs with jerks.	Bent connecting rod.
d. Wiper works only in one direction.	Broken connecting rod. Valves are bent or sticky.
e. Cleaner will not run.	Air line plugged. Valve defective or broken. Gear sector broken. Wiper valve or piston gummed up due to foreign deposits, due to dirty air line.

DEFROSTERS

Two types of defroster are provided: The hot air and the electric fan types. Hot air defroster vents are located on top of windshield body frame. See "Heating System" in "Air Conditioning Manual".

Electric fans are installed on lower panel of destination sign compartment and can be removed by loosening two fan supporting nuts. Fan switches are located under fuse panel at top left of driver's compartment.

DRIVER'S SEAT ADJUSTMENT

To adjust seat fore and aft, lift back of seat slightly and slide to desired position. To raise seat vertically, slide seat forward as far as possible and tip up or raise back to desired height. Then slide to rear as far as possible and lift front edge of cushion as high as possible. Then slide forward to desired fore and aft position. Reverse procedure to lower seat. See Fig. No. 12.

DRIVER'S SEAT CURTAIN

Driver's seat curtain is contained in lower railing tube in back of seat, where it is attached by means of chrome plated end brackets. Curtain hooks onto upper package compartment and it is so constructed that when rolled, end of curtain will be parallel to roller.

FOOT REST

Adjustable foot rests are provided in the back of each aisle chair. Pressing release lever permits twelve different adjustments of foot rest to conform with passenger requirements.

PASSENGER SEAT ADJUSTMENT

Passenger seat backs are adjustable by means of seat lift located at forward end of arm chair. Four and six adjustments are provided, according to model.

PASSENGER WINDOW SHADE

Each passenger window is provided with molded plastic shades with positive shade stop.

AIR HORN

Air horn is located in horn compartment, under tool compartment, and is accessible from under front left corner of coach. Air horn foot valve has replaceable packing gland on valve control plunger.

FRONT EMBLEM LIGHT

Front emblem light is located at center of front panel emblem moulding, under windshield. It has one bulb accessible through switch and fuse panel (center panel) compartment. Light is operated by "SIGN" switch button in conjunction with all front and side signs and night light.

TARGET SIGN

Target sign is located on top of rear license plate compartment door. It has five bulbs accessible for replacing by removing retainer screws holding lens door to body. Light is operated by "SIGN" switch.

SIDE DESTINATION SIGN

Side destination sign (optional equipment) is of the built-in illuminated type with large glass opening for white letters on black background. It is located above first right hand window, and it is operated manually by crank from rear top of entrance door post. Three light bulbs are accessible through glass window opening by removing six retainer screws. Removal and installation of glass is accomplished in same manner as for windshield glass, providing correct size rubber channel is used.

Brakes

Instructions and Illustrations in This Group Apply to Following Subjects.

- Air Brake Control
- Air Compressor
- Carbon Trap
- Safety Valve
- Air Tanks
- Pressure Regulating Valves
- Slack Adjusters
- Brake Shoes
- Hand Brakes
- Lubrication Points

Instructions Applying to Related Parts of Brakes Will be Found in Following Groups.

Group Name	Group No.	Group Name	Group No.
Front Axle	1.7601	Control Linkage	12.8901
Rear Axle	2.10281	Lubrication	13.371
Wiring Diagrams	7W.0001	Wheels	19.9101
Engine	8.7101		

All air controlled units with air line connections are shown in their relative positions on "Air Line Diagram". Each unit on diagram is numbered and these numbers are keyed as to name, location, and group in which they are discussed on pages preceding the diagram. Only units pertaining to brake control are discussed in this group.

AIR BRAKE CONTROL

Brief outline of brake air control is as follows: (Refer to Air Line Diagram.)

Pressure is created by compressor (41) and is directed through supply line to carbon trap (30), then to first vertical air tank (21 - toward inside of coach). This tank is commonly called the "Wet" tank, as moisture from system primarily accumulates in this tank. The moisture is automatically syphoned from system (after set pressure is reached) through action of regulating valve (23).

Air pressure is directed into the two vertical tanks, and the first horizontal tank (toward rear of coach) until operating pressure of 60 lbs. is reached in the three tanks. Air pressure is then directed to second horizontal tank through a check valve (10).

Air pressure is constant into system until set pressure is reached. At that pressure, action of regulator valve (23) allows air to escape to atmosphere. First tank has drain tube within 1/8" of bottom of tank and when valve (23) opens, any water collected in tank is carried out to atmosphere by air passing out of valve.

The first vertical tank or "Wet" tank does not supply air directly to any operating units but serves only as the initial receiving tank and to trap any existing moisture.

The second vertical tank acts as supply tank for relay valve (29), heating system magnet valve (32), and winter shutter cylinders (33) and thermostats (36).

The first rear horizontal tank (16 - toward rear of coach) acts as supply tank for brake operating valve (6), stop switch (1), transmission air shift valve (12) and cylinder (35).

The second (front) horizontal tank acts as supply tank to air horn (3), windshield wiper (5) and gauge (9). This tank receives air supply only after operating pressure of 60 lbs. is reached in other three supply tanks.

AIR COMPRESSOR

Air compressors used with gasoline and Diesel engines are similar in construction except methods of drive. Compressor used with gasoline engine is illustrated in Figs. 1 and 3, while compressor used with Diesel engine is

AIR COMPRESSOR

No.	Name
1.	Cylinder Head Cover
2.	Cylinder Head Cover Gasket
3.	Discharge Valve Spring
4.	Discharge Valve
5.	Seat
6.	Cylinder Head Plug
7.	Cylinder Head Assembly
8.	Compression Ring
9.	Piston
10.	Welch Plug
11.	Piston Pin
12.	Oil Ring
13.	Scraper Ring
14.	Lockwire
15.	Connecting Rod Assembly
16.	Connecting Rod Bolt
17.	Cylinder Head Stud
18.	Cylinder Head Gasket
19.	Crankshaft Oil Seal Assembly
20.	Front End Cover Assembly
21.	Crankshaft End Cover Gasket
22.	Front Cover Bushing
23.	Inlet Chamber Cover
24.	Inlet Chamber Cover Gasket
25.	Cylinder Block
26.	Connecting Rod Bolt Nut
27.	Connecting Rod Cap
28.	Crankshaft Nut
29.	Crankshaft Key
30.	Crankshaft
31.	Rear Cover Bushing
32.	Rear End Cover Plug
33.	Rear End Cover Assembly
34.	Rear End Cover Gasket
35.	Piston Pin Bushing

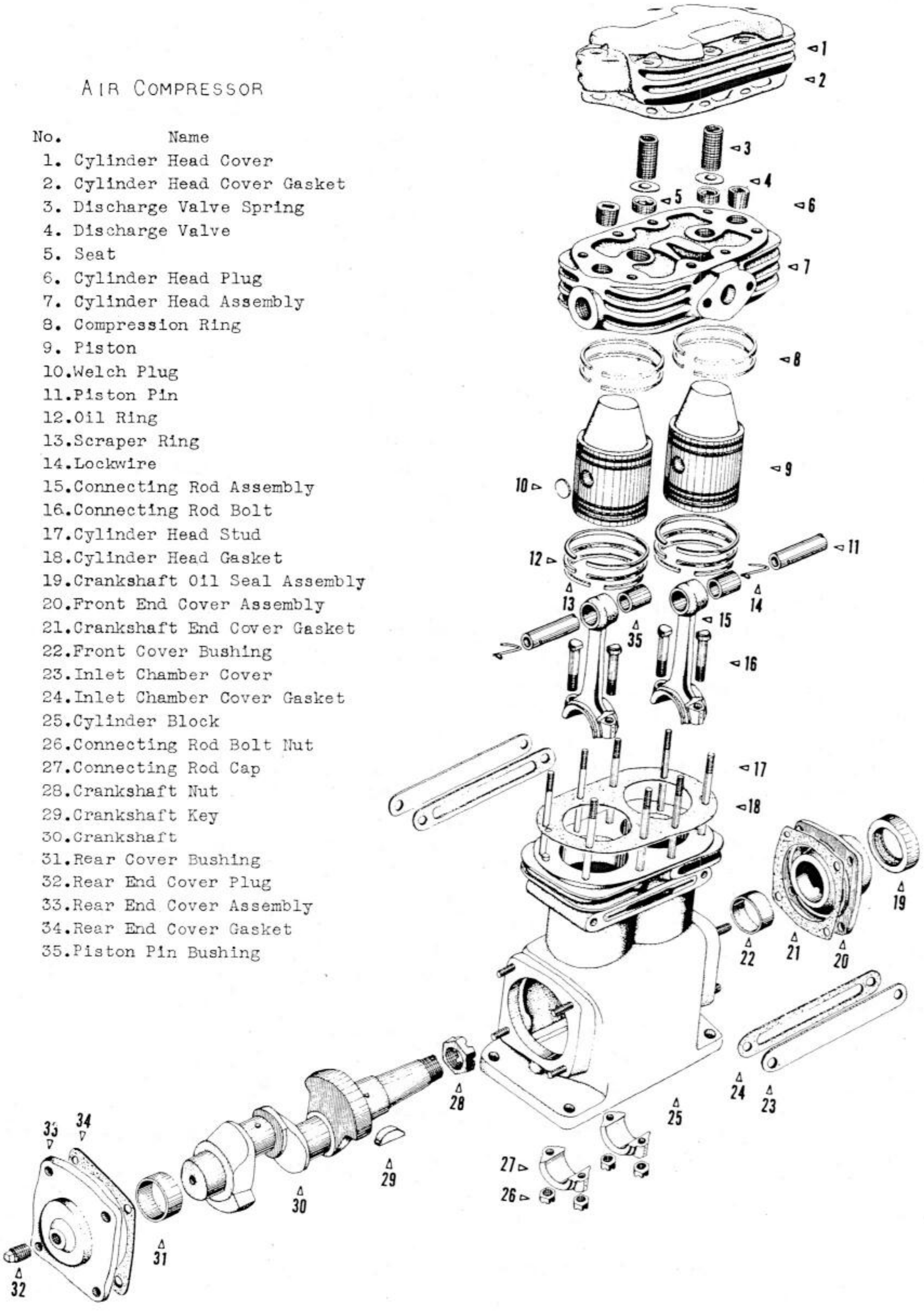


Fig. 1 Component Parts of Compressor Used With Gasoline Engine.

AIR COMPRESSOR

No.	Name
1.	Cylinder Head Cover
2.	Cylinder Head Cover Gasket
3.	Discharge Valve Spring
4.	Discharge Valve
5.	Seat
6.	Cylinder Head Plug
7.	Cylinder Head Assembly
8.	Compression Ring
9.	Piston
10.	Welch Plug
11.	Piston Pin
12.	Oil Ring
13.	Scraper Ring
14.	Lockwire
15.	Connecting Rod Assembly
16.	Connecting Rod Bolt
17.	Cylinder Head Stud
18.	Cylinder Head Gasket
19.	Inlet Chamber Cover
20.	Inlet Chamber Cover Gasket
21.	Cylinder Block
22.	Connecting Rod Bolt Nut
23.	Connecting Rod Cap
24.	Crankshaft Nut
25.	Crankshaft Key
26.	Crankshaft
27.	Rear Cover Bushing
28.	Rear End Cover Plug
29.	Rear End Cover Assembly
30.	Rear End Cover Gasket
31.	Piston Pin Bushing
32.	Crankcase Cover Gasket
33.	Crankcase Cover
34.	Cover Screw

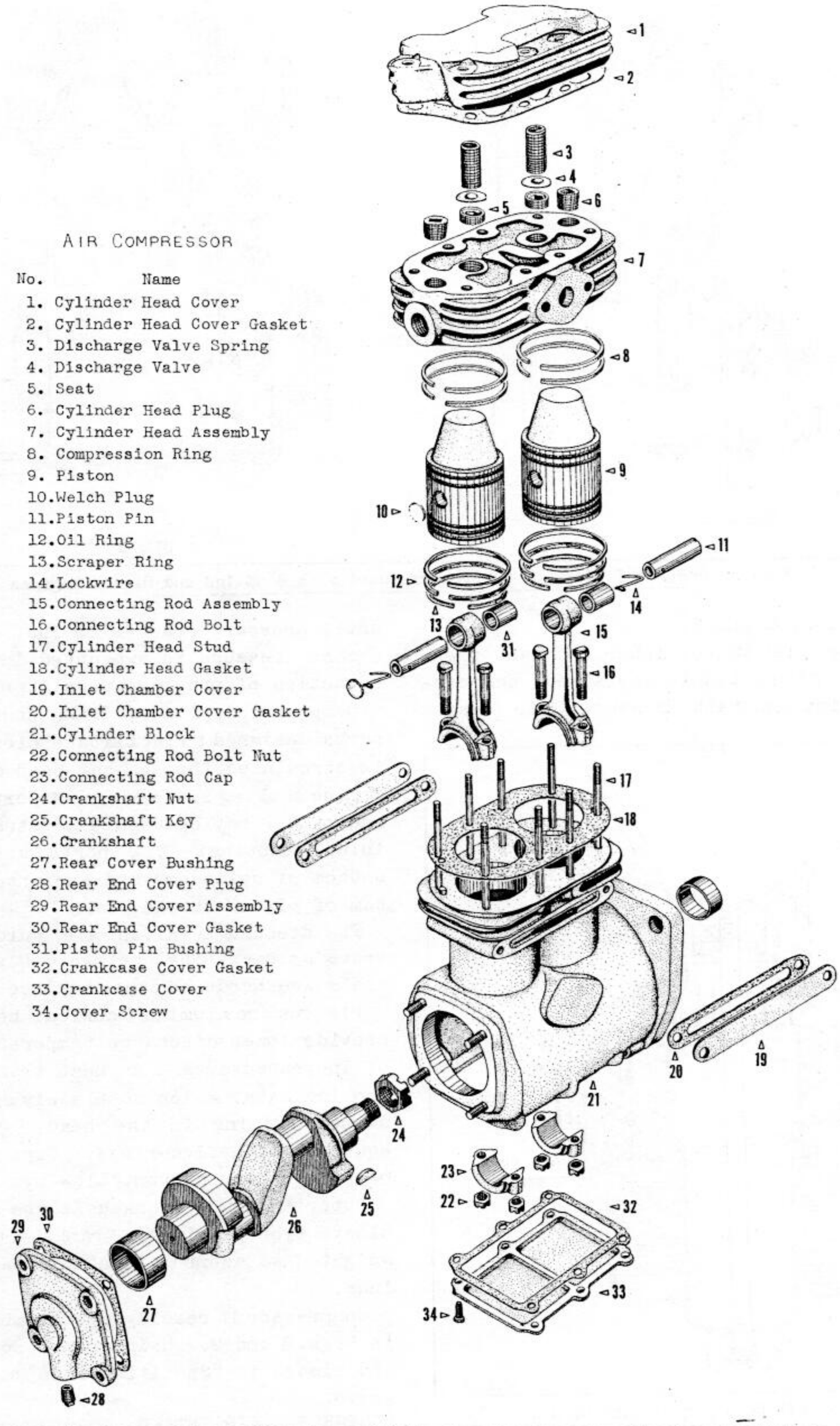


Fig. 2 Component Parts of Compressor Used With Diesel Engine.

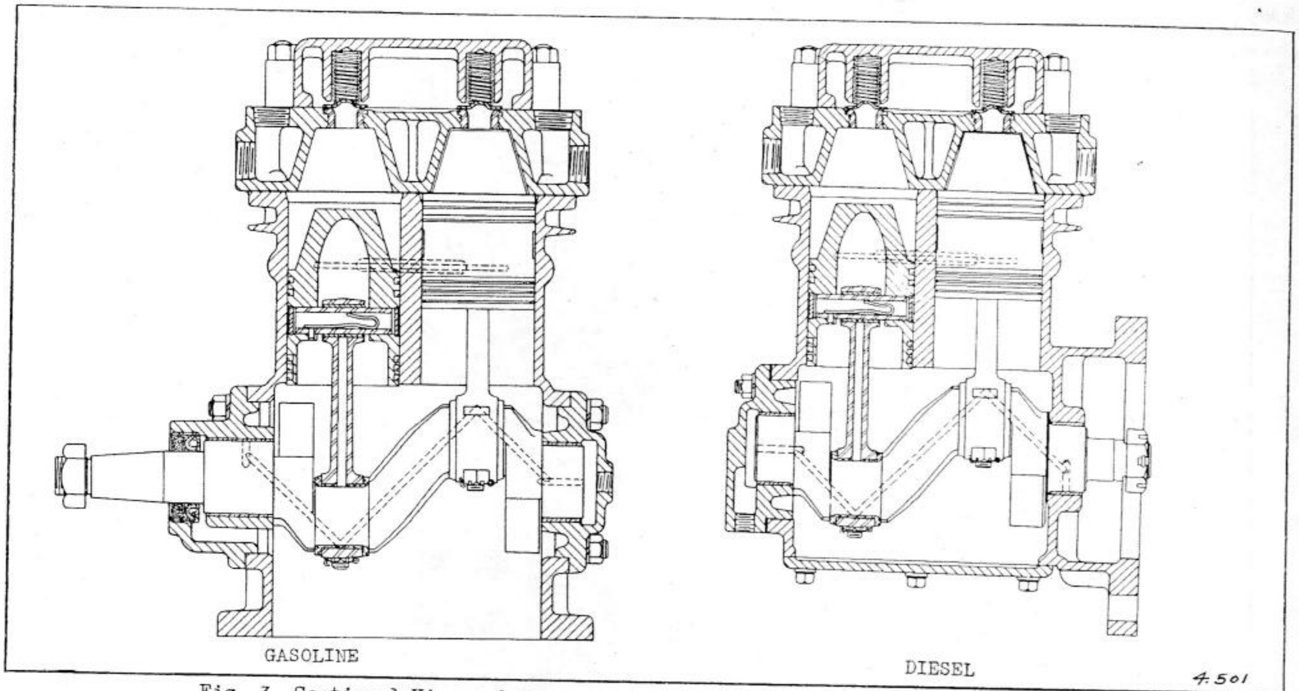


Fig. 3 Sectional Views of Compressors used with Gasoline and Diesel Engines

shown in Figs. 2 and 3.

Compressor is two-cylinder constant pressure type. As previously explained, compressor maintains constant pressure into system until pressure reaches 85 lbs. at which time excess pressure is exhausted into atmosphere by action of pressure regulator valve.

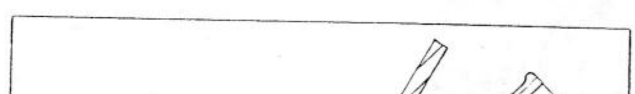


Fig. 4 Oil Bath Air Cleaner Used
With Air Compressor

Compressor cylinder head consists of two parts designed to facilitate cleaning. Water is circulated through sub-head directly from engine cooling system. Inlet ports are slotted and either may be used for strainer or air inlet mounting. The ports are located at bottom of cylinders and are uncovered at bottom of piston stroke.

The discharge valves are guided to valve seats by operating springs. Discharge valve seats are hardened steel replaceable inserts.

Pistons are aluminum conical head type which provide lower discharge temperatures because of increased area for heat transfer to the cooling water which completely surrounds cone shaped opening in the head. Pistons are equipped with five-rings. Caps at both ends of piston pins prevent blow-by.

Outer ends of crankshaft are supported by sleeve type bearings. Crankshaft is counterweighted adjacent to front and rear main bearings.

Compressor is readily disassembled, as shown in Figs. 1 and 2. Maintenance specifications are listed in "Specifications" at end of this group.

COMPRESSOR AIR INTAKE

Compressor air intake is through small oil

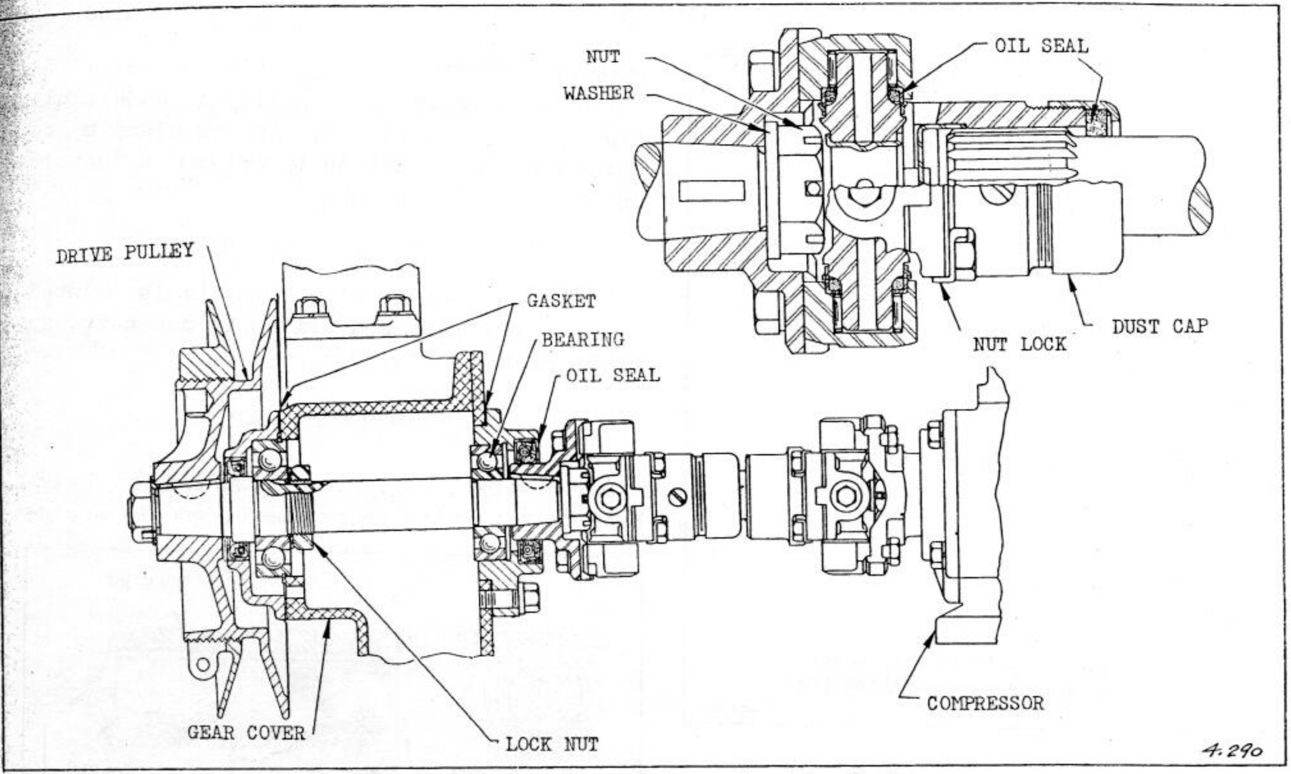


Fig. 5 Air Compressor Drive on Gasoline Engine

bath type air cleaner (Fig. 4) mounted at top of engine compartment and connected to air intake on compressor by tubing. This air cleaner should be cleaned at regular intervals and refilled with proper grade of engine oil.

COMPRESSOR DRIVE

GASOLINE ENGINE

Compressor used on gasoline engine is mounted on oil pressure regulator housing and is belt driven by crankshaft pulley through short propeller shaft, as illustrated in Fig. 5.

Short pulley stub drive shaft, as illustrated, is mounted on two ball type bearings which are held in place in caps by pulley hub at front end and universal joint flange at rear end. Each end of housing is sealed by spring loaded leather oil seal assemblies which prevents oil leakage at those points.

Drive shaft assembly between hub stub shaft and compressor proper is a short conventional propeller shaft equipped with slip joint at front end and fixed joint at compressor.

Each universal joint consists of two yokes, journal or cross, and four needle bearing assemblies. Bearing assemblies are contained in cap or shrouds and are removed or installed as complete assemblies.

Universal joints can be disassembled by removing cap screws holding each bearing and cup assembly in place. Mark shaft and slip joint before removing joint in order to reassemble in same relative place.

Install bearings on opposite ends of cross. Engage one bearing in yoke on flange pilot and swing opposite bearing into place. If bearing does not enter readily, due to compression of cork packing or because of oil-bound condition, tap outer edge of bearing with babbitt hammer.

Lugs of lock plates at each cap screw should be turned against face of screw head.

LUBRICATION OF JOINTS

Journal in each universal joint assembly is drilled to provide lubricant to each bearing assembly.

In the face of one bearing cap on each joint assembly will be found a filler hole cap screw. When necessary to lubricate joints, remove cap screw and install standard lubrication fitting in its place. After lubricating joint remove lubricating fitting and reinstall filler hole cap screw, using new copper gaskets under head of screw.

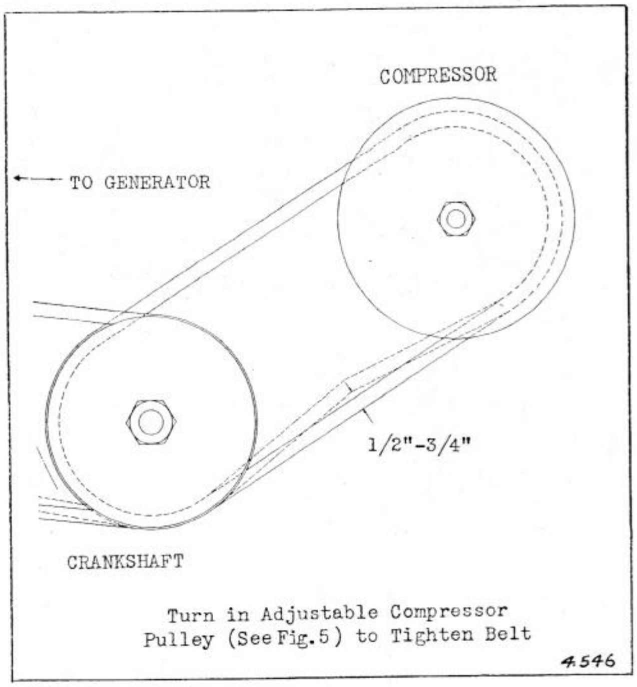

COMPRESSOR
← TO GENERATOR
1/2"-3/4"
CRANKSHAFT
Turn in Adjustable Compressor
Pulley (See Fig.5) to Tighten Belt
4546

Fig. 6 Adjust Air Compressor Belt as Shown

To lubricate slip joint, remove slotted screw in sleeve, and install lubrication fitting. Reinstall screw after sleeve is lubricated.

Refer to Lubrication chart for specifications.

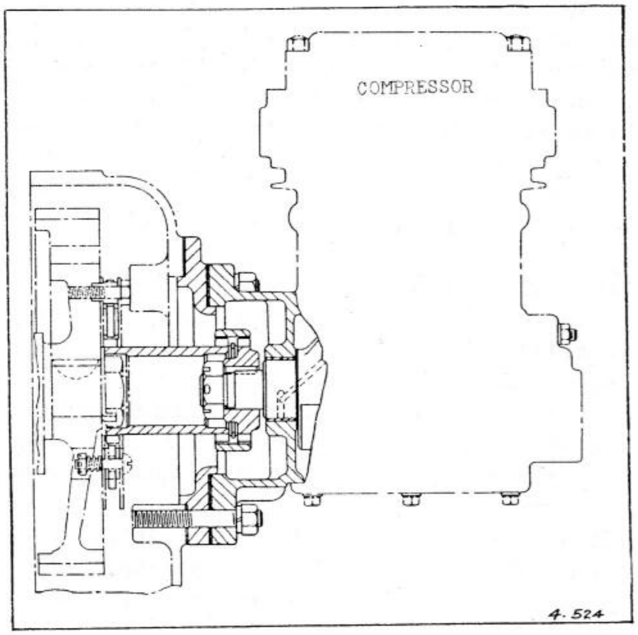


Fig. 7 Compressor Drive on Diesel Engine

BELT ADJUSTMENT

Air compressor drive pulley is adjustable type, as shown in Fig. 6. Loosen clamp bolts and turn outer section in or out to obtain proper belt deflection.

DIESEL ENGINE DRIVE

Air compressor on Diesel engine is mounted at rear of engine and driven by camshaft, as illustrated in Fig. 7.

CARBON TRAP

Carbon trap, Fig. 8, is mounted on bulkhead of generator compartment, and is accessible for repair purposes through opening under coach. Air line connections are shown at 30 - on Air Line Diagram. This unit serves two purposes. First, it removes from air stream all particles of carbon which may have formed in compressor and which might lodge on air valve seats or clog air lines. Second, trap serves to cool air from compressor by means of cooling fins around the case, thereby protecting lines which would otherwise be damaged by air passing through them at high temperatures direct from compressor.

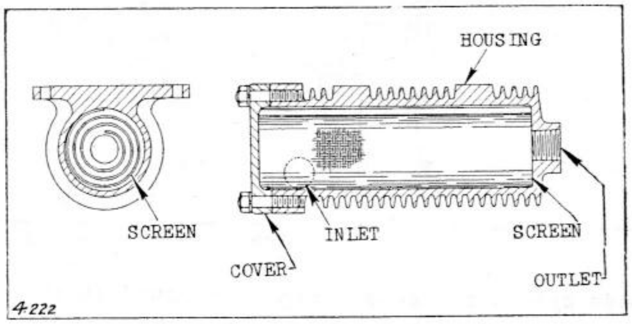


Fig. 8 Sectional View of Carbon Trap

MAINTENANCE

Carbon trap should be inspected at least every 10,000 miles and cleaned if necessary. Take off cap and remove screen, placing it in benzol, or coal tar naphtha for at least ten or fifteen minutes to loosen carbon particles and oil sludge which have lodged in screen. Blow screen out clean, and also clean out inside of trap housing.

Carbon trap is equipped with drain cock. Trap should be drained daily.

SAFETY VALVE

Safety valve is mounted on carbon trap and is set at 140 lbs. Valve should be checked regularly for leaks, and thoroughly cleaned and adjusted once a year.

AIR TANKS

As previously explained under "Air Brake Control", four supply tanks are used in air system. The two rear vertical tanks (see item 21 on Air Line Diagram) are mounted just ahead of right rear wheel, as shown in Fig. 9. The inner vertical tank acts as receiving tank and is equipped with drain tube automatically operated by action of valve ("1" - Fig. 10). When pressure in system reaches 85 lbs., valve opens to syphon moisture from this tank. This tank does not serve as supply tank to any operating units.

The outer vertical tank serves as supply tank for relay valve, heating system magnet valve, and winter shutter units, as previously explained.

The vertical tanks are accessible for service purposes from underneath coach. Wheel housing panel may be removed to withdraw tanks from mountings if desired.

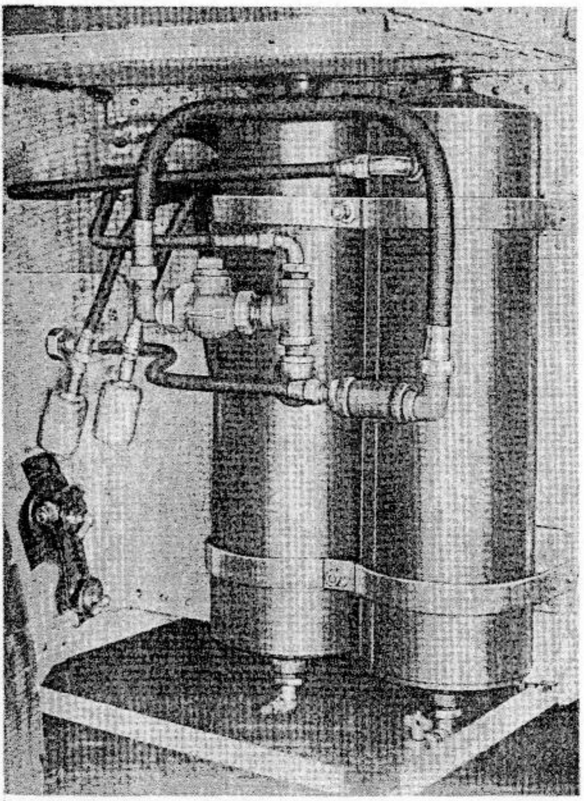
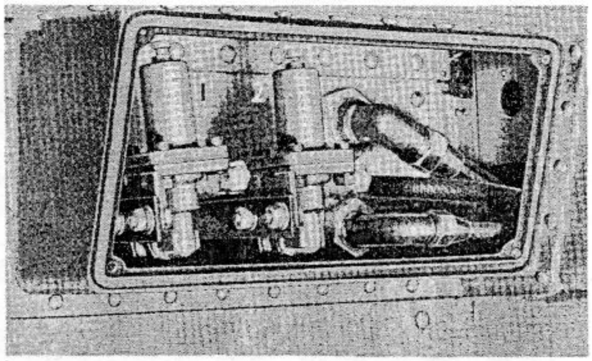


Fig. 9 Vertical Tanks are Mounted Ahead of Right Rear Wheel.



1. Pressure Reg. Valve and Auto. Drain
2. Pressure Reg. Valve (Auxiliary)

Fig. 10 Pressure Regulator Valves are Mounted in Right Rear Baggage Compartment

The two horizontal supply tanks are under coach just ahead of front axle. The rear horizontal tank acts as supply tank for brake operating valve, stop switch, transmission shift valve and cylinder, as previously explained. The front horizontal tank supplies air horn and windshield wipers.

CHECK VALVES

Check valve, connected between the two vertical tanks, Fig. 9, prevents air from discharging from the outer vertical and the two horizontal tanks in case a connection between compressor and inner vertical tank leaks or becomes disconnected. In this manner, existing supply of air in other tanks can be used to brake the vehicle. This valve must be installed with arrow toward center of coach and screw plug at top, as shown in Fig. 9.

Check valve (located in tool compartment) shown as item 10 on Air Line Diagram, prevents air pressure from entering front horizontal tank until pressure in other tanks reaches 60 lbs. operating pressure. This valve further permits air to return to rear horizontal tank in the event pressure in that tank falls below operating pressure of 60 lbs. The housing of this check valve is marked with an arrow. Unit must be installed with arrow toward outside of coach.

AIR PRESSURE GAUGES

Two air pressure gauges are used in air

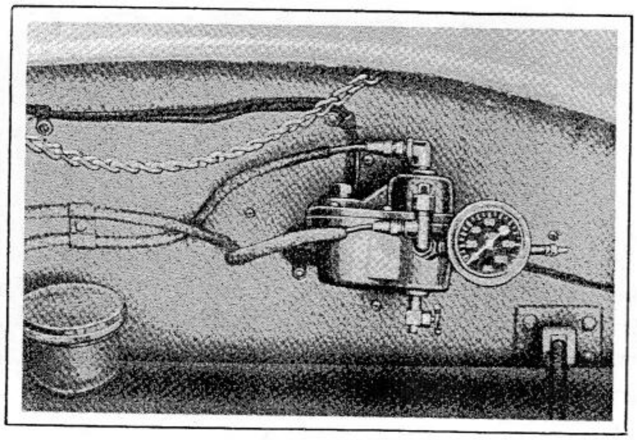


Fig. 11. Air Filter, Gauge, and Supply Fitting is Mounted as Shown. Air Filter is Described in "Cooling" Group.

system. Gauge at instrument panel is connected to forward horizontal or auxiliary tank, as shown on Air Line Diagram. Gauge in engine compartment is mounted, as shown in Fig. 11 and registers pressure in entire system.

The gauge at instrument panel will not register until pressure in main tanks exceeds 60 lbs. at which time the gauge will start to show pressure in auxiliary tank. Only after entire pressure of system is raised to 60 lbs. pressure will readings on gauge at instrument panel and at engine compartment coincide. As pressure in main tanks falls below 60 lbs., air from auxiliary tank bypasses into main tanks. The readings on the two gauges will coincide as pressure falls.

As the operating pressure is built up again, the gauge at instrument panel will not show increase until main line pressure exceeds 60 lbs., as shown by gauge in engine compartment.

The reading on instrument panel gauge is definitely a signal to driver. Vehicle should not be put into motion until this gauge registers 60 lbs. or over. When gauge shows a reading of less than 60 lbs., vehicle should be stopped and an immediate inspection of system should be made to determine cause of low pressure.

LOW PRESSURE INDICATOR

Low pressure indicator, Fig. 12, is mounted in tool compartment and is connected in air line system between check valve and brake application valve (see item 11 on Air Line Diagram). The indicator is simply an electropneumatic device that automatically closes an electrical circuit to operate a light on instrument panel when pressure falls below 45 - 55 lbs. It automatically cuts out, opening circuit, when air pressure is built up to exceed 55 lbs.

Body of indicator supports stationary contact which is fully insulated. Movable contact is carried on indicator diaphragm which rests on seat in body and is held securely by diaphragm seat washer and cover which screws into body.

Upper terminal is insulated from cover and electrical circuit is through helical valve spring to movable contact and then to stationary contact.

In operation, lower side of diaphragm is open to air line pressure. Indicator is adjusted to operate signal at 45 to 55 pound line pressure. As long as pressure is above this setting, diaphragm is held upward, compressing valve spring and holding contacts open. However, if for any reason line pressure should fall below this setting, spring pressure exceeds line pressure, forcing diaphragm downward and closing contacts. Signal in driver's compartment then indicates to operator that pressure is below that at which vehicle can be operated safely.

INSPECTION

Low pressure indicator should be inspected

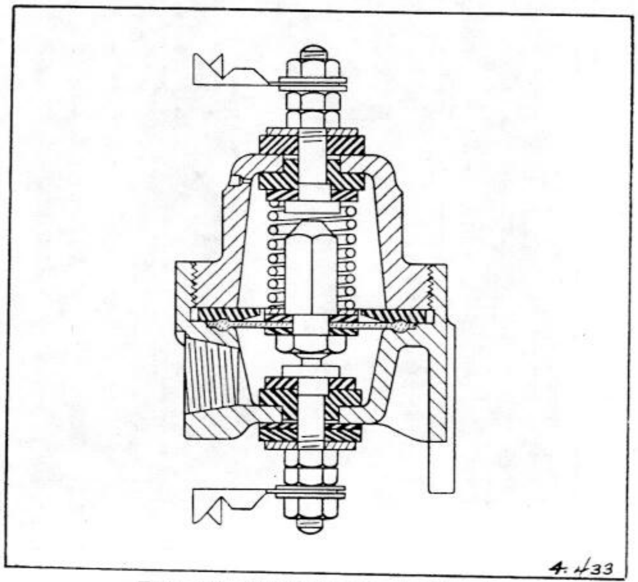


Fig. 12 Low Pressure Indiacator is Mounted in Tool Compartment

at periodic intervals. The following checks will give an accurate check of the indicator's condition:

1. Bleed down pressure. Light should cut in at 45 lbs.
2. Build up pressure again. Light should cut out at 55 lbs.
3. Check contact points for corrosion and diaphragm for leakage.

Refer to Wiring Diagram for electrical connections.

MAINTENANCE

The contact points may become corroded and pitted until a true contact cannot be obtained. File down points with a fine cut point file.

The diaphragm should be replaced at least once a year with a new diaphragm assembly.

Only means of adjusting this unit is by use of shims between spring and diaphragm to increase spring tension or grinding spring to decrease tension.

PRESSURE REGULATING VALVES

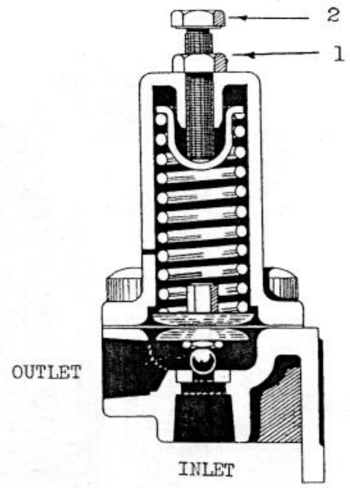
Three pressure regulating valves of the type shown in Fig. 13 are used in air control system. See items 13, 22, and 23 on Air Line Diagram.

Two pressure regulating valves are mounted in a housing located in right rear baggage compartment, as shown in Fig. 10. The third regulator valve is located in tool compartment, as indicated by item 13 on Air Line Diagram.

The two regulator valves regulate pressure from compressor to main tanks. When pressure in main tanks reaches 90 lbs., regulator valve (1 - Fig. 10) allows air to escape to atmosphere. Action of this valve also automatically drains moisture from inside vertical tank.

Pressure regulator valve (2 - Fig. 10) is set to open at 100 lbs. and operates only in the event the first valve becomes inoperative. In the event both valves become inoperative, system is protected by action of safety valve (located on carbon trap) which is set to exhaust at 150 lbs. pressure.

Pressure regulator valve mounted in tool compartment is adjusted at 60 lbs. and does not permit air to flow to front horizontal tank until main tank pressure has built up to that setting. In this manner, air cannot be exhausted from main system for use of wipers or horn.



Refer to Air Line Diagram
Items 13,22 and 23

Fig. 13. Sectional View of Pressure Regulator Valve.

Outlet pipes of the two regulator valves mounted in right rear baggage compartment directs escaping air through mufflers which minimizes objectionable noise. These mufflers are mounted near vertical tanks, as shown in Fig. 9.

ADJUSTMENT

Regulating valves, set and sealed at factory are marked with setting on valve body. This marking indicates CLOSING pressure. If necessary to adjust valve, proceed as follows:

1. Loosen lock nut (1 - Fig. 13) on outer valve (1 - Fig. 10).
2. Turn down adjusting screw (2 - Fig. 13) as far as it will go. This places setting above the second valve.
3. Adjust valve (2 - Fig. 10) to start to open at approximately 100 lbs. (This valve should close at 95 lbs.)
4. Adjust valve (1 - Fig. 10) to start to open at 90 lbs. (This valve should close at 85 lbs.)

NOTE: Each valve is marked with CLOSING Pressure. The valve will START TO OPEN at approximately 5 lbs. ABOVE THIS SETTING.

LEAKAGE TEST

Build up pressure until gauge is below that of original valve setting. Coat outlet port

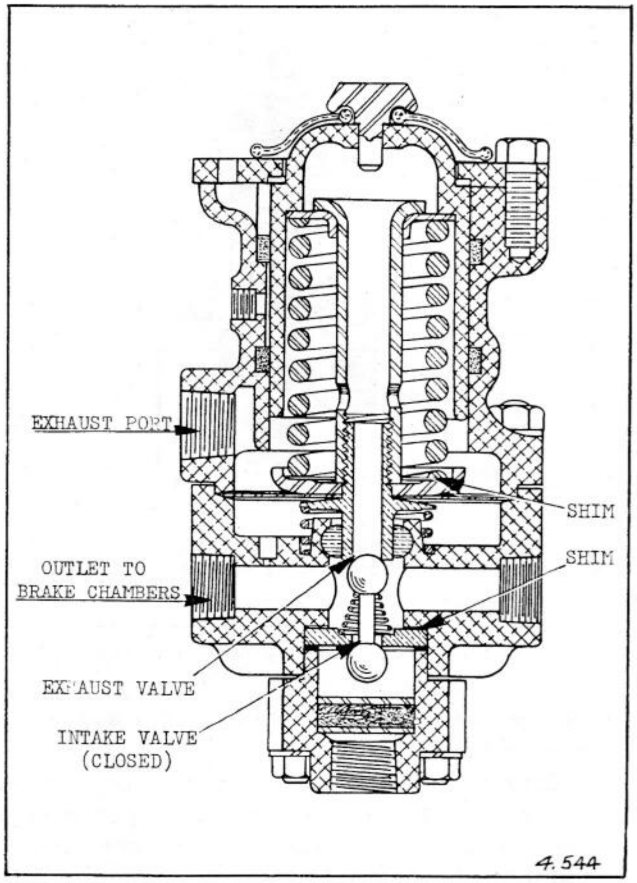


Fig. 14. Sectional View of Brake Application Valve.

with soap suds. Leakage is caused by ball not seating properly, or by worn valve seat. As a general rule, when valve seat is found worn, the diaphragm will also be worn. If such is the case, it is more economical to replace with a reconditioned valve. The valve mechanism should be thoroughly washed with gasoline at least every six months.

Supply and Test Fittings

The outside supply fitting is located at air filter, as shown in Fig. 11. The test fitting is located on floor of tool compartment. These fittings are designated on Air Line Diagram as items 14 and 37. The supply fitting permits charging of supply tanks from an outside source. The test fitting is used to test brake application valve.

Air Lines

Air lines are of annealed copper tubing with flexible tubing at front and rear brake chambers. All line connections should be inspected at periodic intervals. Air lines extending from front of vehicle to rear are mounted in duct which is accessible by removing plates in roof of baggage compartment. The line junction or connections at front of vehicle (item 7 on Air Line Diagram) are accessible through hand hole in roof of spare tire compartment.

Brake Application Valve

Application valve, Fig. 14, is located underneath toe board on left side of coach. Brake treadle is located immediately over application valve. As brake, clutch and accelerator pedal linkages are closely allied, descriptions and illustrations applying to this linkage is shown in "Fuel" group of this book. Refer to Air Line Diagram for air line connections to application valve.

APPLICATION

Application valve operated by foot pressure controls brake operation by directing flow of air from reservoir to brake chambers in brake application, and from brake chambers to atmosphere in release. Depression of foot pedal causes diaphragm to deflect, thus closing exhaust valve and opening intake valve.

Application valve is of pre-loaded type and is designed so as to gradually deliver increased air pressure to brake chambers as brake pedal is depressed.

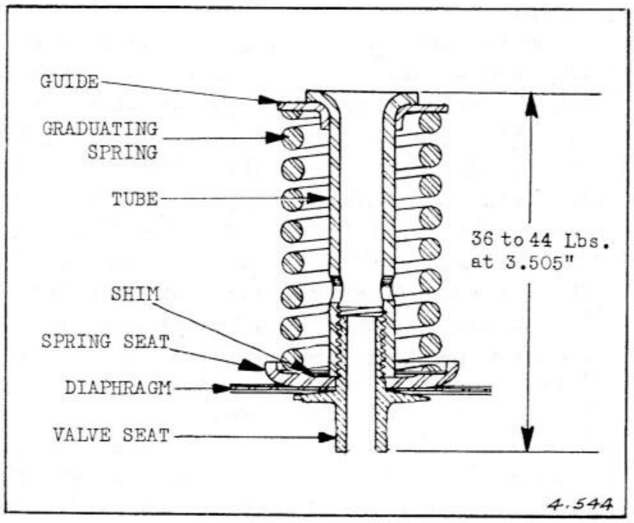


Fig. 15. Brake Application Valve Diaphragm Assembly.

To test graduated range of valve, attach pressure gauge to test fitting (see item 14 on Air Line Diagram) and apply brakes slowly. Gauge should jump from zero to 4-1/2 or 5-1/2 up in first step, then gradually move to 60 - 65 pounds.

Stop screw located under brake pedal at forward end should be adjusted so as to prevent further travel of pedal.

DIAPHRAGM

Diaphragm assembly is illustrated in Fig. 15. Pre-loading of spring is accomplished by exhaust valve seat which is threaded inside exhaust valve tube and locked securely by special plug.

Spring pressure can be adjusted by shims placed between spring and spring seat. Spring pressure should be held to 36 to 44 pounds when dimension is 3.305 as shown in Fig. 12. If pre-loaded more than specified, brake will operate severely and tend to grab because of initial harder application, also diaphragm may be damaged.

INTAKE AND EXHAUST VALVE

Intake and exhaust valve is shaped similar to a dumb bell. Upper ball acts as exhaust valve and is always open when brakes are in released position. (Fig. 14). At first application, opening between ball and exhaust seat is closed, thus closing off the escape of air. Intake valve is always seated, as shown in Fig. 15, when brakes are in released position, thus not allowing air pressure to enter lower chamber and wheel cylinders.

As brake pedal is moved toward application position, graduating spring deflects diaphragm downward, closing exhaust valve and opening intake valve, permitting air pressure to pass from reservoir to brake chambers. When air pressure in brake chambers and cavity below diaphragm is strong enough to balance pressure placed on graduating spring, it lifts the diaphragm and compresses graduating spring so that both the intake and exhaust valves are held closed. Further lever movement toward application position compresses the spring still further and causes the balance to be established at a higher pressure. Movement toward released position removes pressure from graduating spring, while air pressure lifts diaphragm, permitting exhaust valve to open and exhaust air from brake chambers until a lower balance is reached. This balancing feature gives driver a fine degree of brake control, enabling him to graduate the brake on or off as conditions demand.

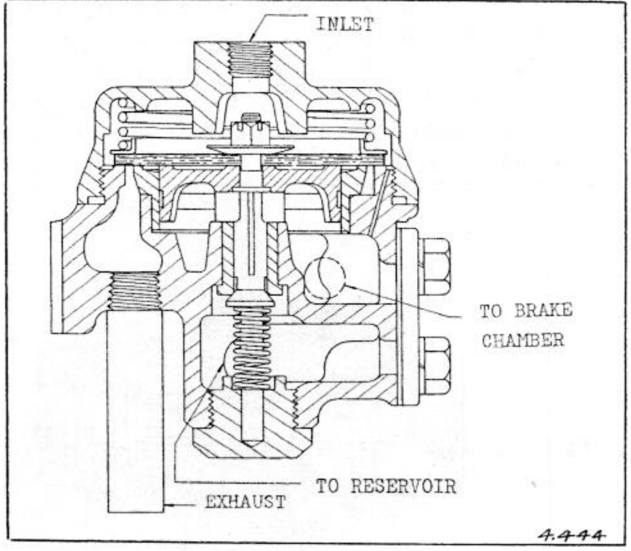


Fig. 16 Sectional View of Relay Valve.

BRAKE VALVE TESTS

Brake valve should be tested for leakage and delivery pressure at end of each 5000 miles. This can be done without removing it from vehicle by having reservoir charged to 100 pounds and testing as follows:

1. With foot pedal in released position, check distance between treadle roller and valve button - this should be 1/16". This free travel of pedal can be adjusted by loosening lock nut on adjusting screw and turning screw counter-clockwise to increase pedal travel and clockwise to decrease travel.
2. With foot pedal in released position, test intake valve for leakage by applying soap suds on exhaust port.
3. With foot pedal in applied position, test exhaust valve for leakage by applying soap suds on exhaust port.
4. Connect test gauge to test fitting (see item 14 on Air Line Diagram), and test delevered pressure by depressing foot pedal. If pressure obtained is less than 60 - 65 lbs., pedal should be adjusted at screw under foot pedal.
5. If either intake or exhaust valve leaks excessively, brake valve should be checked for dimensions shown in Fig. 15, and valves inspected. Complete unit may be returned to manufacturer for reconditioning.

VALVE INSPECTION

Inspect valve seats for dust or carbon deposits. After thorough cleaning of valves, measure width of valve seat. If seat is worn wider than 1/32", an efficient leakproof seat cannot be obtained and parts must be replaced. If leakage persists after valves are reconditioned, it can usually be corrected by installing additional shims between inlet valve seat and body.

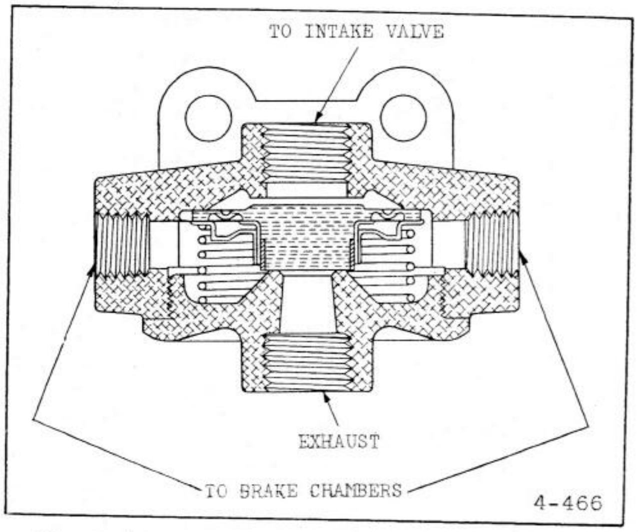


Fig. 17 Sectional View of Quick Release Valve.

LUBRICATION AND CARE

Light engine oil should be put in oil cup every 1,000 miles in order to keep felt washers lubricated.

Application valve should be removed, disassembled, and thoroughly cleaned every 50,000 miles. Apply coat of petrolatum to all moving parts before reassembling. Diaphragm should be replaced every two years.

RELAY VALVE

Relay valve, Fig. 16, is used to speed up application and release of rear brakes. This unit (item 29 on Air Line Diagram) is mounted under floor of coach to rear of rear axle. Air pressure in rear brake chambers is exhausted rapidly to atmosphere on release thru the relay valve.

TEST

1. With brakes released, cover exhaust port with soap suds. Leakage is caused by supply valve not seating properly.
2. With brakes applied, cover exhaust port with soap suds. Leakage is caused by diaphragm not seating properly.

MAINTENANCE

Relay valve diaphragm is subject to service wear and should be replaced once each year, or more often when operating conditions are unusually severe. If leakage is caused by diaphragm, both diaphragm and diaphragm seat should be wiped clean with gasoline-saturated rag. If leakage is caused by intake valve, remove valve, clean valve and valve seat with kerosene, and then regrind valve. Valve should be ground with a small amount of fine abrasive. Only a slight pressure is necessary. Always wash valve and seat thoroughly with gasoline after regrinding operations.

If intake valve is excessively worn, it will be found more economical to replace entire relay valve with a reconditioned unit.

QUICK RELEASE VALVE

Quick release valve, Fig. 17, speeds up the release of air from front brake chambers. This unit (item 15 on Air Line Diagram) is mounted on floor under coach to the rear of horizontal air tanks.

INSPECTION

Quick release valve should be inspected at periodic intervals. With brakes applied, cover exhaust port with soap suds. Leakage is caused either by dirt on exhaust seat or a worn exhaust seat.

Remove diaphragm and clean seat with kerosene. If seat is worn, replace diaphragm. Diaphragm should be replaced at least once a year.

BRAKE CHAMBERS

Front brake chambers are illustrated in Fig. 20, while rear chambers are shown in Fig. 21. Also refer to Air Line Diagram.

Air brake chamber consists of two-piece housing between which diaphragm is clamped. Air line is connected to one side of chamber, and a push plate and rod assembly is fitted in opposite side and connected to slack adjuster, which is mounted to brake shoe camshaft.

Front chambers are mounted on each steering knuckle, while rear chambers are mounted on rear axle housing between the springs.

INSPECTION

Brake chambers should be inspected at regular intervals as follows:

1. With soap suds, coat around edges of diaphragm and around bolt holes. In case of leakage, tighten bolts uniformly until leakage is eliminated. Do not tighten bolts to the extent that diaphragm will become distorted.
2. Check push rod travel as explained under "Adjusting Brakes".

MAINTENANCE

Brake diaphragms should be replaced every 50,000 miles or at least every two years. Check condition of rubber boots periodically. These should be replaced if cracked. The boots should be treated with a suitable rubber lubricant.

SLACK ADJUSTERS

Slack adjuster used at each front and rear brake is sectionally illustrated in Fig. 18 and also illustrated in Figs. 20 and 22. The slack adjuster spline is mounted on spline of brake shoe camshaft and held in place with retainer plate.

The most efficient brake action will be obtained when the slack adjuster arm travel is held to a minimum so that full length of lever is used. The brake adjustments necessary to maintain proper slack adjuster arm travel are made by turning adjusting worm, Fig. 31. This rotates worm gear together with camshaft and cam, expanding brakes so that slack caused by brake lining wear is taken up and slack adjuster arm travel is returned to minimum setting. Refer to "Adjusting Brakes".

MAINTENANCE

Worm gear and worm should be lubricated at regular intervals. Lubrication fillings are provided on body of each slack adjuster.

The replaceable bushings fitted into holes in slack adjuster arms should be inspected at each major vehicle inspection and replaced if necessary.

FRONT BRAKE SHOES

There are two shoes on each front brake which swivel at one end on anchor pins and are expanded by constant lift cam. Component parts of front shoes, camshaft slack adjuster and brake chamber are shown in Fig. 20.

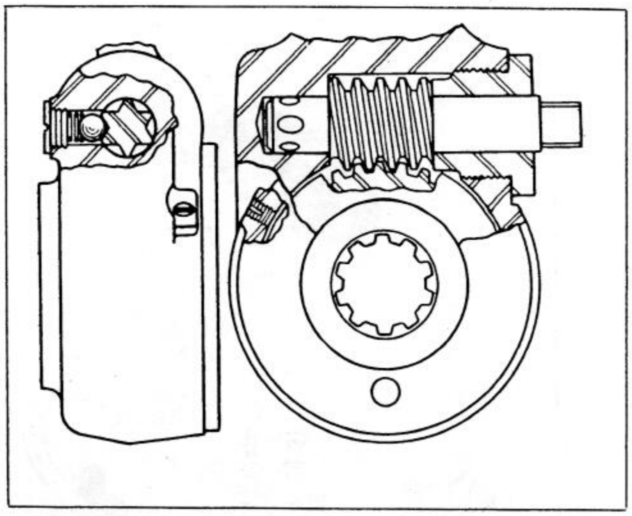


Fig. 18. Sectional View of Slack Adjuster.

Front camshaft, Fig. 19, is mounted on two needle type bearings which are retained in place in brake spider. Outer and inner ends of bearings are equipped with oil seals.

Anchor pins are held in place with a retaining plate which engages slot in each pin. Lock plate is retained with a screw.

REMOVING SHOES (Refer to Fig. 20)

1. Remove wheel, hub, and drum.
2. Remove both retracting springs (8).
3. Remove anchor pin lock plates (18).
4. Pull anchor pins (12) through shoes.
5. Shoes may then be swung clear.

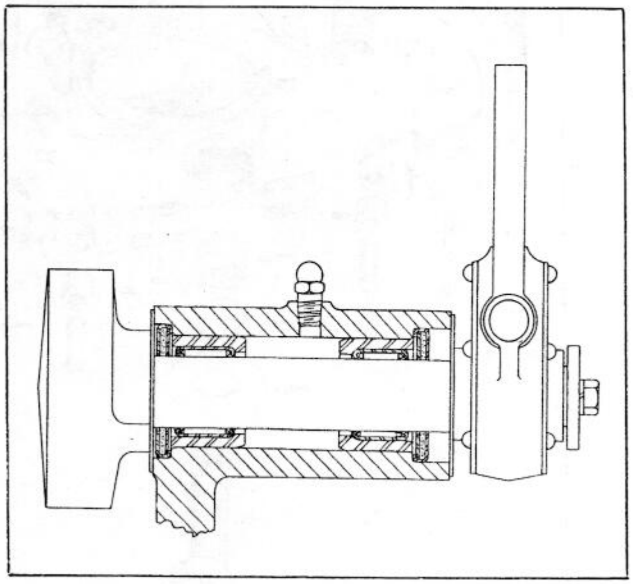
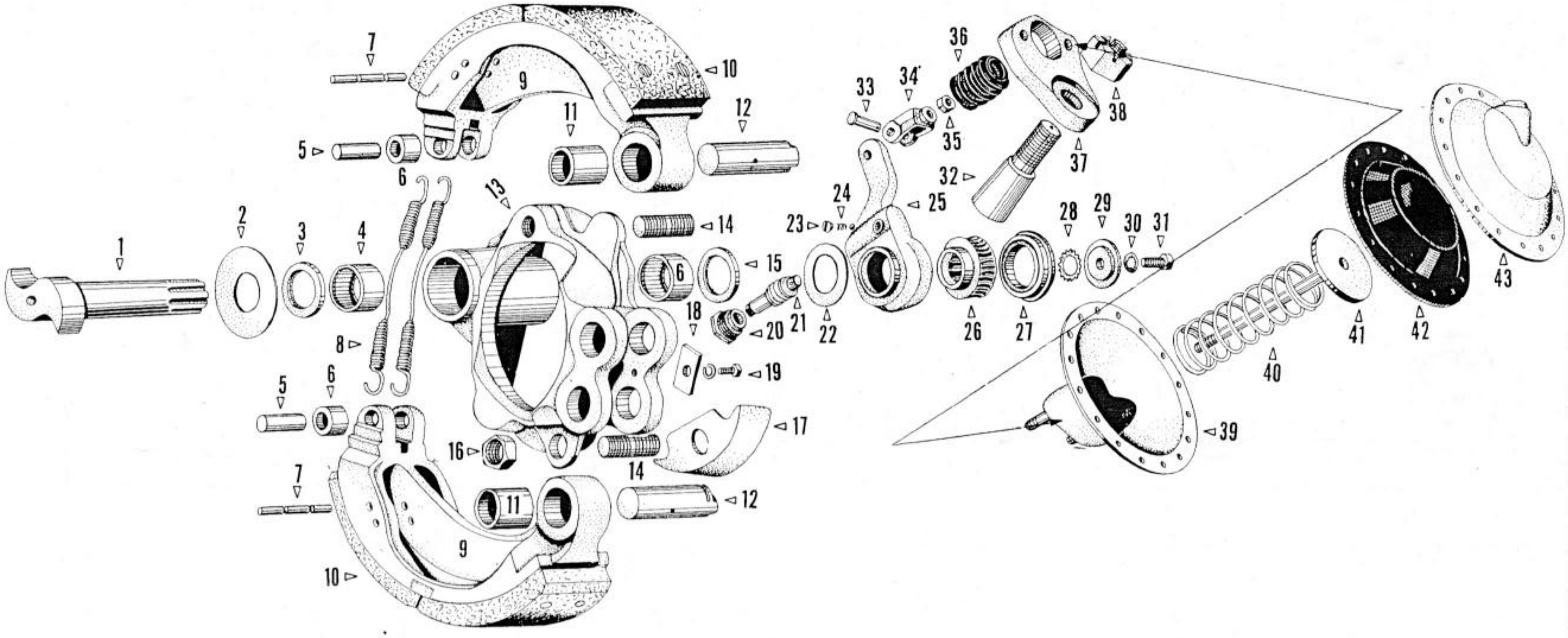


Fig. 19. Front Brake Camshaft and Mounting.



1. Camshaft
2. Washer
3. Oil Seal (Outer)
4. Bearings
5. Roller Pin
6. Roller
7. Spring Pin
8. Spring
9. Brake Shoe
10. Shoe Lining
11. Shoe Bushing
12. Anchor Pin
13. Spider
14. Spider Stud
15. Oil Seal (Inner)
16. Stud Nut
17. Grease Slinger
18. Anchor Pin Lock
19. Lock Screw
20. Adjuster Stop Nut
21. Adjuster Worm
22. Spacing Washer
23. Plug
24. Spring
25. Adjuster Lever
26. Worm Gear
27. Worm Gear Cover
28. Retaining Washer
29. Retaining Washer
30. Retaining Washer
31. Retainer Set Screw
32. Bracket Stud
33. Yoke Pin
34. Chamber Yoke
35. Yoke Nut
36. Boot
37. Chamber Bracket
38. Bracket Stud Nut
39. Non-Pressure Plate
40. Push Rod Spring
41. Chamber Push Rod
42. Chamber Diaphragm
43. Pressure Plate

Fig. 20. Front Brake Shoes, Slack Adjuster, and Brake Chamber

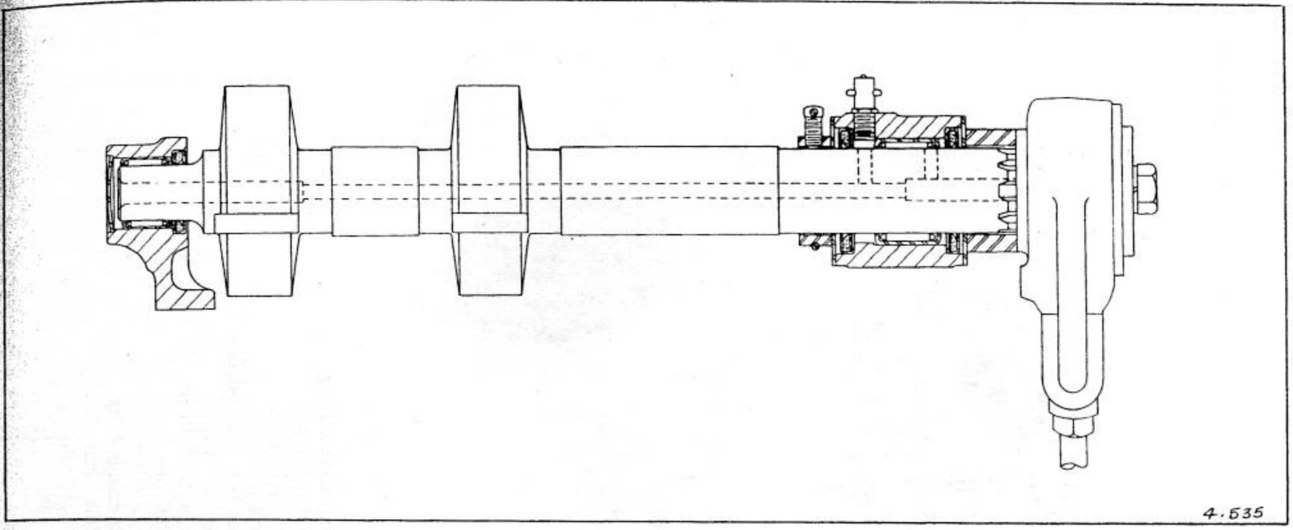


Fig. 21. Rear Brake Camshaft and Mountings.

If necessary to remove camshaft, proceed as follows:

1. Remove slack adjuster screw (31) and retaining plate (29).
2. Remove slack adjuster assembly (25).
3. Pull camshaft (1) out through spider.

INSTALLING SHOES (Refer to Fig. 20)

Two brake blocks are fastened to each shoe with flat head countersunk bolts. Blocks should not have over .006" clearance between back of lining and brake shoe at any point.

Tollers (6) at cam ends of shoe assemblies should be replaced if appreciably worn. Anchor pin bushings (11) in shoes are reamed after assembly. (See "Specifications".)

Install shoes in following manner:

1. Examine camshaft needle bearings (4) and replace if worn. Roll small quantity of grease into each bearing assembly. Examine oil seals at each end of shaft and replace if necessary.
2. Install bearings in brake spider.
3. Install camshaft and slack adjuster.
4. Install shoes. Insert anchor pins into shoes and install lock plate and screw.
5. Check retracting springs before installation. (See "Specifications" for test dimensions.)
6. Back off slack adjuster so that shoe rollers are on lowest point of cam.
7. Clean hubs, hand pack wheel bearings, and adjust as described in "Wheels" group. Reinstall drums and adjust brakes as described under "Adjusting Brakes".

REAR BRAKE SHOES

Four brake shoes at each rear brake are mounted in pairs, as shown in Fig. 22. The four shoes are actuated by a single brake chamber. One camshaft operates two integral constant lift cams which expand brake shoes.

Camshaft inner and outer ends are mounted in needle type bearings, Fig. 21. Outer bearing is mounted in a bracket bolted to brake spider, while inner bearing is mounted in bracket held in place on axle housing with stud and nut. Inner and outer brackets are equipped with oil seals at each end of bearings. Camshaft is dulled full length to provide lubricant to outer bearing when lubricated at fitting on inner bearing bracket.

Anchor pins for both pairs of shoes are retained in place in spider with set screws. Outer and inner ends of anchor pins are equipped with retaining washers and lock rings.

Each pair of shoes is equipped with retracting springs, ends of which are hooked on pin on each shoe.

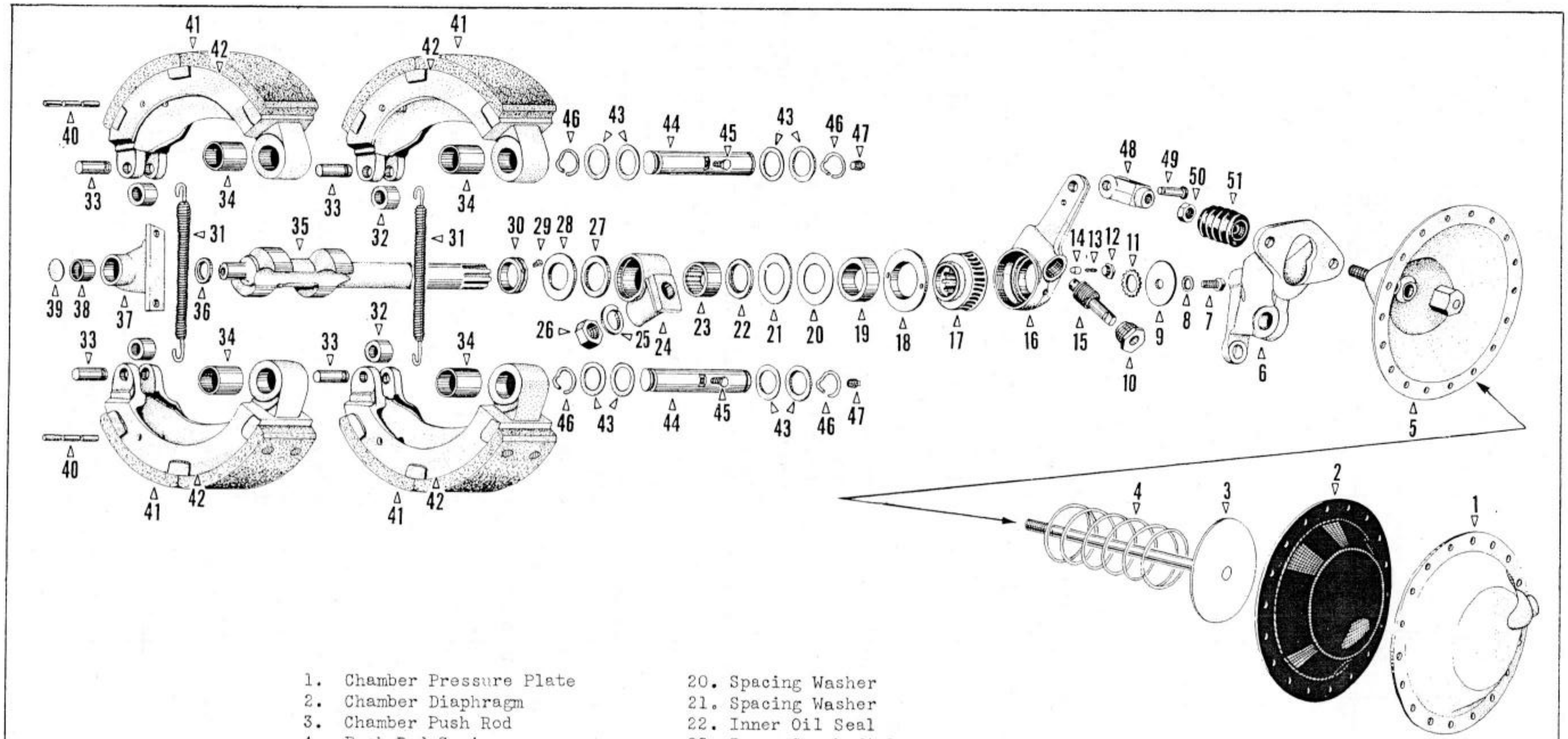
REMOVING REAR SHOES (Refer to Fig. 22)

1. Remove drum, hub and axle shaft.
2. Remove both brake shoe retracting springs.
3. Remove outer anchor pin lock rings (46).
4. Outer shoes may then be removed.
5. Remove anchor pin set screws and lock rings at inner ends. Pull out anchor pins. Inner shoes may then be removed.

If necessary to remove camshaft, proceed in following manner:

Fig. 20. Front Brake Shoes, Slack Adjuster, and Brake Chamber.

4.12



1. Chamber Pressure Plate
2. Chamber Diaphragm
3. Chamber Push Rod
4. Push Rod Spring
5. Chamber Plate
6. Chamber Bracket
7. Adjuster Retain. Bolt
8. Washer
9. Adj. Retain Washer
10. Adjusting Stop Nut
11. Lockwasher
12. Plunger Plug
13. Plunger Spring
14. Plunger
15. Adjuster Worm
16. Adjuster Lever
17. Worm Gear
18. Worm Gear Cover
19. Adjuster Spacer
20. Spacing Washer
21. Spacing Washer
22. Inner Oil Seal
23. Inner Camshaft Brg.
24. Inner Camshaft Brkt.
25. Lock Washer
26. Nut
27. Camshaft Oil Seal
28. Spacing Washer
29. Collar Set Screw
30. Camshaft Collar
31. Shoe Spring
32. Shoe Roller
33. Roller Pin
34. Shoe Bushing
35. Camshaft
36. Outer Oil Seal
37. Outer Bracket
38. Outer Bearing
39. Expansion Plug
40. Spring Pin
41. Shoe Lining
42. Brake Shoe
43. Anchor Pin Washer
44. Anchor Pin
45. Pin Lock Screw
46. Pin Lock
47. Pin Plug
48. Chamber Yoke
49. Yoke Pin
50. Yoke Nut
51. Boot

Fig. 22. Rear Brake Shoes, Slack Adjuster and Brake Chamber

1. Remove outer camshaft bearing bracket (37).
2. Loosen collar set screw (29).
3. Remove slack adjuster retaining plate (9) and slack adjuster (16).
4. Pull camshaft out through brake spider.

INSTALLING REAR SHOES (Refer to Fig. 22)

Two brake blocks are fastened to each shoe with flat head countersunk bolts. Blocks should not be over .006" clearance between back of lining and brake shoe at any point.

Rollers (32) at cam ends of shoes should be replaced if appreciably worn. Anchor pin bushings (34) in shoes are reamed after assembly (see "Specifications").

Install shoes in following manner:

1. Examine camshaft needle bearings (23 and 38) and replace if worn. Roll small quantity of grease into each bearing assembly. Examine oil seals at each end of brackets (36 and 22), and replace if necessary.
2. Install bracket (24) and bearing assembly (23) on axle housing.
3. Install camshaft (35) and locking collar (30).
4. Install outer bracket (37) and bearing on spider and camshaft. Make certain that plug (39) is in end of bracket (37).
5. Place inner pair of shoes in position and insert anchor pins (44). Secure anchor pins with set screws and install inner locks (46) on pins. Install inner retracting spring (31) on shoes.
6. Install outer pair of shoes and outer locks on anchor pins.
7. Install slack adjuster on camshaft. Make certain that collar (30) is secured with set screw (29).
8. Back off slack adjuster so that shoe rollers are on lowest point of cam.
9. Clean hubs and hand pack wheel bearings.
10. Install hub, wheel bearings, drum, and axle shaft. Adjust wheel bearings as directed in "Wheel" group.
11. Adjust brakes as described under "Adjusting Brakes".

ADJUSTING BRAKES

With slack adjusters used on these brakes, a complete and perfect adjustment can be made as the vehicle stands on highway or on service floor. If the push rod travel is held to a minimum, increased life of brake chamber diaphragm can be obtained as well as reduced air consumption.

Following steps are suggested in making brake adjustments:

1. Build up pressure to at least 80 lbs. and maintain at least 60 lbs. while brakes are being adjusted.
2. For first adjustment on new brakes, or if original adjustment has been disturbed, jack up each wheel and turn slack adjuster until brake shoes are tight against drums.
3. Back off slack adjuster until wheel is free. Check to see that there is between .008" and .010" clearance at toe end of shoe. Apply brakes; note and record brake chamber push rod travel. This maximum travel when brakes are adjusted correctly should be 3/4".
4. The push rod travel should be the same for both chambers on each axle. On this vehicle, the maximum travel when brakes are adjusted should be 3/4" while maximum stroke at which brakes should be readjusted is 1-3/4".
5. The brakes should be readjusted every 1000 miles or more often in very severe service. This check may be made by applying brakes and measuring brake chamber push rod travel. If this travel is more than it was on the original adjustment, brakes should be readjusted, decreasing travel to 3/4".
6. Wheel bearings should be checked at each brake adjustment. Loose wheel bearings will affect brake adjustment.

BRAKE DRUMS

Brake drums which are out-of-round in excess of .010" should be re-machined or reground.

Brake drums should never be ground or machined more than 1/8" over original diameter.

Drums machined out more than this are liable to warp and become bell-shaped, thereby rendering brakes ineffective.

Drums may be reground up to .030" oversize without necessitating use of oversize linings. Always check inside diameter of drums and if it is necessary to machine them more than .030" oversize of new drums to clean up, drums should be machined to 1/8" oversize and 1/16" oversize brake linings used. Beyond this limit, new drums must be installed.

Fig. 22. Rear Brake Shoes, Slack Adjuster and Brake Chamber

BRAKES

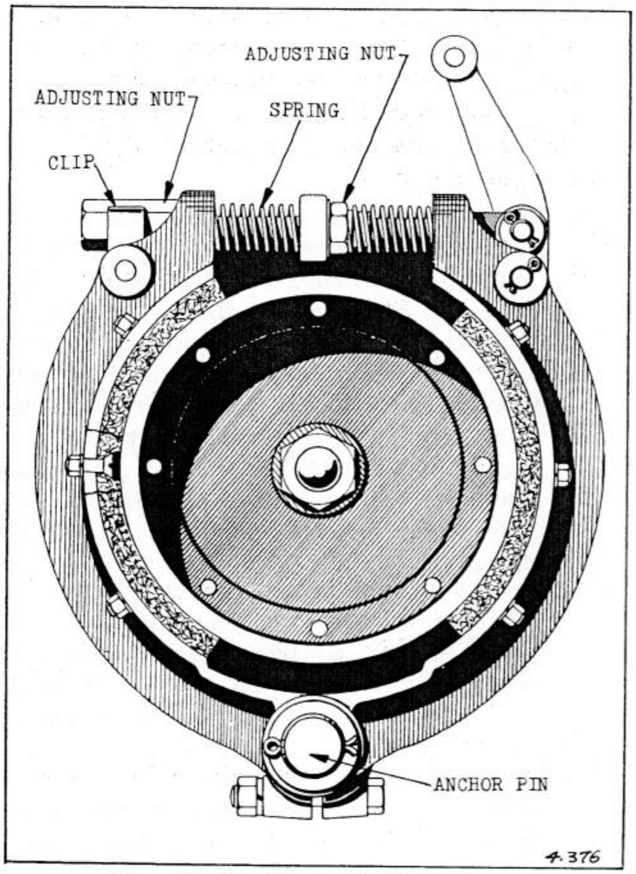


Fig. 23 Hand Brake is Mounted on Transmission Angle Drive

HAND BRAKE

Hand brake, shown in Fig. 23, is two-shoe contracting type, operated through rods and bell-cranks by hand lever at left of driver. Each shoe is provided with one-piece block type lining held in place with flat head cap screws and nuts. Brake blocks are counterbored to permit maximum amount of wear on linings before heads of bolts are in danger of scoring drum.

Lower ends of shoes are mounted on eccentric anchor pin with tang on rear end to permit turning pin when adjusting brake shoe clearance. Clamping bolts in anchor pin bracket should always be kept tight to prevent pin turning.

Upper ends of shoes are adjustable independently of each other to secure proper lining clearance.

Brake shoes are interchangeable as rights and lefts, and can be removed after disconnecting lever and removing adjusting nuts and anchor pin.

BRAKE ADJUSTMENT

When making initial adjustment of anchor pin, turn pin until both shoes have at least .020" clearance at bottom.

Turn inner adjusting nut first, then outer nut, until there is .030" - .040" clearance between upper ends of linings and drum.

Be sure anchor pin clamp bolts are tight and that adjusting nuts are held securely by their clips.

BRAKE CONTROL RODS

As brake control rods and linkage are closely allied to accelerator and clutch linkage, descriptions and illustrations of this linkage will be found in "Fuel" group of this book.

LUBRICATION POINTS

Following is a description of operations necessary to lubricate service brakes and controls. Refer to Lubrication Chart (Group 13) for lubricant specifications and periods.

1. Brake anchor pins - eight fittings, two at each wheel - accessible from underneath vehicle. Use pressure gun.
2. Brake camshafts - four fittings, one at each wheel - accessible from underneath vehicle. Use pressure gun.
3. Brake slack adjusters - four fittings, one at each wheel - accessible from underneath vehicle. Use pressure gun.
4. A compressor air cleaner - clean air cleaner and element - refill to level marked on cleaner body. Accessible through engine compartment.
5. Air compressor joints - two fittings - one in each joint - located in face of bearing caps. Remove filler hole cap screws, insert lubrication fitting. Fitting must be removed after lubrication and cap screws inserted. Accessible through engine compartment. Use pressure gun.
6. Air compressor slip joint - one fitting - remove slotted screw and insert fitting. Fitting must be removed after lubrication and slotted screw inserted. Accessible through engine compartment. Use pressure gun.

LUBRICATION POINTS

7. Air compressor drive bearings - Automatically lubricated from engine.
8. Air chamber clevis, pin and boot - four points - one at each wheel. Accessible from underneath vehicle. Use spray gun.
9. Brake pedal hingepin - accessibly through fog lamp opening. Use spray gun.
10. Hand brake cross shaft needle bearings. Packed at assembly.
11. Control rod ball cranks - thru fittings with grease tubes, located at engine bulkhead - accessible from underneath vehicle. One fitting for hand brake control. Use pressure gun.
12. Hand brake idler shaft bracket (or bell crank) - one fitting, accessible through right hand engine compartment door. Requires gun with long hose. Place gun on fitting from transmission inspection door. Use pressure gun.
13. Hand brake anchor - two fittings, accessible through transmission inspection door. Use pressure gun.
14. Hand brake control linkage. Accessible through air conditioning compartment and engine compartment. Use spray gun.

SPECIFICATIONS

BRAKES

FRONT BRAKES

Brake Diameter--------------------14-1/2"
LINING
Length--------------------------7-5/16"
Width ---------------------------------4"
Thickness--------------------------3/4"

RETRACTING SPRING
Free Length---------------------8-3/8"
Lbs. Pull @ 9"--------------------50-60

ANCHOR PIN
Diameter------------------1.248"-1.246"

ANCHOR PIN BUSHING
Inside Diameter-Burnish----1.254"-1.256"

CAM ROLLER
Inside Diameter--------------.754"-.756"

ROLLER PIN
Diameter --------------------.748"-.749"

FRONT BRAKE CHAMBER
Minimum Push Rod Travel-------------3/4"
Maximum Push Rod Travel----------1- 3/4"

REAR BRAKE

Brake Diameter--------------------14-1/2"
LINING
Length --------------------------7-5/16"
Width---------------------------------4"
Thickness---------------------------3/4"
RETRACTING SPRING
Free Length----------------------9-1/8"
Lbs. Pull @ 9-3/4"-----------------85-95

ANCHOR PIN
Diameter -------------------1.250"-1.248"

ANCHOR PIN BUSHING
Inside Diameter-Burnish-----1.254"-1.256"

CAM ROLLER
Inside Diameter---------------.754"-.756"

ROLLER PIN
Diameter----------------------.748"-.749"

REAR BRAKE CHAMBER
Minimum Push Rod Travel--------------3/4"
Maximum Push Rod Travel------------1-3/4"

AIR COMPRESSOR
Make-----------------------Westinghouse
Model - for Gasoline Engine-------2UCE8VW
Model - For Diesel Engine---------2UCE8FW
Piston Ring Gap---------------.005"-.010"
Ring Clearance in Groove-------.001"-.003"
Discharge Valve Travel--------.073"-.089"
Connecting Rod Clearance------.000"-.0016"
Connecting Rod Thrust--------.0035"-.0075"

AIR PRESSURE GAUGES
Operating Range---------------60-110 Lbs.

SAFETY VALVE SETTING ------------150 lbs.

PRESSURE REGULATOR VALVE SETTINGS
Regulator (1 - Fig. 10) to Close @---85 lbs.
Regulator (2 - Fig. 10) to Close @---95 lbs.
Regulator at Front to Open @------60 lbs.

SPECIFICATIONS

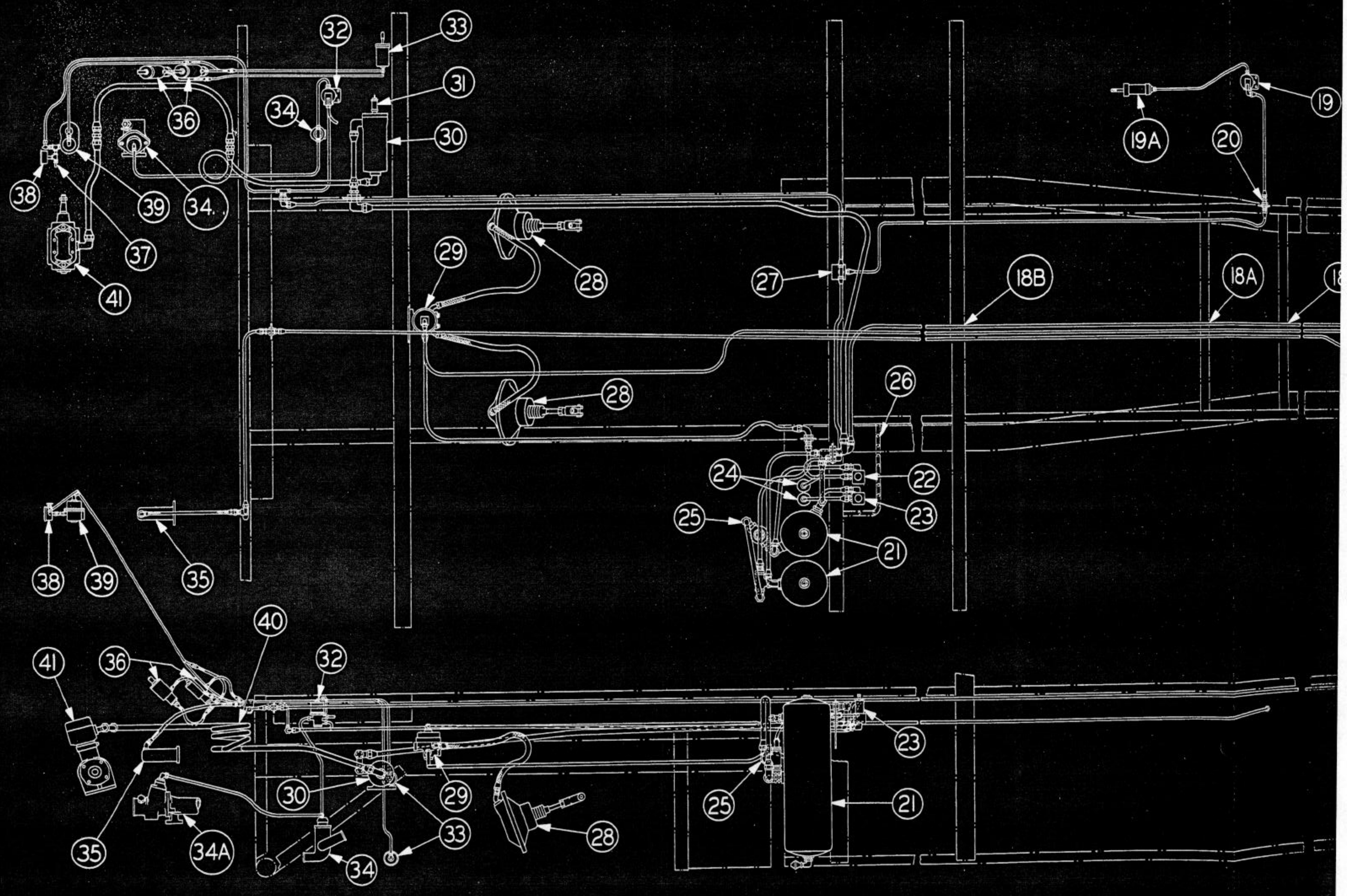
LOW PRESSURE INDICATOR
Set to-------------------------40-55 Lbs.
APPLICATION VALVE
Type------------------------------------D
DIAPHRAGM ASSEMBLY
Lbs. Load @ 3.503----------------36 to 44
Adjustment--------------Shim Under Spring
CLEARANCE BETWEEN PEDAL AND BUTTON---1/16"
APPLICATION VALVE PRESSURE-LBS.-------60-65
Adjustment---------Stop Screw Under Pedal
INLET VALVE SEAT ADJUSTMENT-----------Shim
Shim Thickness---------------.0031"-.010"
CLEAN FILTER-----------Every 10,000 Miles

HAND BRAKE

Type-----------------External Contracting
Drum Diameter--------------------------11"
LINING
Width----------------------------------6"
Thickness----------------------------5/8"
CLEARANCE BETWEEN DRUM & LINING
Top --------------------------.030"-.040"
Bottom ----------------------------.020"
BRAKE SHOE BUSHING
Anchor Pin Hole Burnish---1.7505"-1.7485"
Lever Hole Burnish----------.6245"-.6265"

ITEMS SHOWN ON AIR LINE DIAGRAM

ITEM	NAME	LOCATION	REFER TO GROUP
1	Stop Switch	Tool Compartment	7L
2	Horn Valve	Tool Compartment	3
3	Air Horn	Air Horn Compartment	3
4	Wiper Valves	Dash Left of Instrument Panel	3
5	Wiper Motors	Behind Instrument and Fuse Panels	3
6	Brake Operating Valve	Above Tire Compartment	4
7	Air Line Connections	Above Tire Compartment	4
8	Horn and Wiper Strainer	Tool Compartment	3
8A	Transmission Shift Strainer	Behind Instrument Panel	17
9	Air Gauge	Instrument Panel	4
10	Check Valve	Tool Compartment	4
11	Low Pressure Indicator	Tool Compartment	4
12	Transmission Shift Valve	See "Transmission"	17
13	Wiper Pressure Regulator Valve	Tool Compartment	3
14	Test Fitting	Tool Compartment	4
15	Quick Release Valve	Under Floor To Rear of Horizontal Tanks	4
16	Horizontal Air Tanks	Under Floor- Ahead of Front Axle	4
17	Front Brake Chambers	Front Axle Steering Knuckles	4
18	Tubing Clip	See Diagram	4
18A	Tubing Clip	See Diagram	4
18B	Tubing Clip	See Diagram	4
19	Air Conditioning Magnet Valve	Air Conditioning Compartment	Air Cond.Manual
19A	Air Condition Throttle Control	Air Conditioning Compartment	Air Cond.Manual
20	Connection	In Duct Center Compartment	4
21	Vertical Air Tanks	Ahead of R.H. Rear Wheel	4
22	Pressure Regulator Valve	R.H. Rear Baggage Compartment	4
23	Automatic Drain Valve	R.H. Rear Baggage Compartment	4
24	Regulator and Drain Valve Mufflers	Left of Vertical Tanks	4
25	Check Valve	Rear of Vertical Tanks	4
26	Valve Housing	R.H. Rear Baggage Compartment	4
27	Connections	Duct L.H. Rear Baggage Compartment	4
28	Rear Brake Chambers	On Rear Axle Housing	4
29	Relay Valve	Under Floor - To Rear of Axle	4
30	Carbon Trap	L.H. Engine Compartment	4
31	Safety Valve	On Carbon Trap	4
32	Magnetic Valve	L.H. Engine Compartment	Air Cond.Manual
33	Winter Shutter Cylinders	Ahead of Forward Radiator	6
34	Heater Valve Outlet	L.H. Engine Compartment	Air Cond.Manual
34A	Heater Valve Inlet	See Diagram	Air Cond.Manual
35	Transmission Shift Cylinder	On Transmission	17
36	Shutter Thermostats	L.H. Engine Compartment	6
37	Supply Valve	On Gauge L.H. Engine Compartment	4
38	Air Gauge	L.H. Engine Compartment	4
39	Air Filter	L.H. Engine Compartment	Air Cond.Manual
40	Cooling Coil	See Diagram	4
31	Air Compressor	On Engine	4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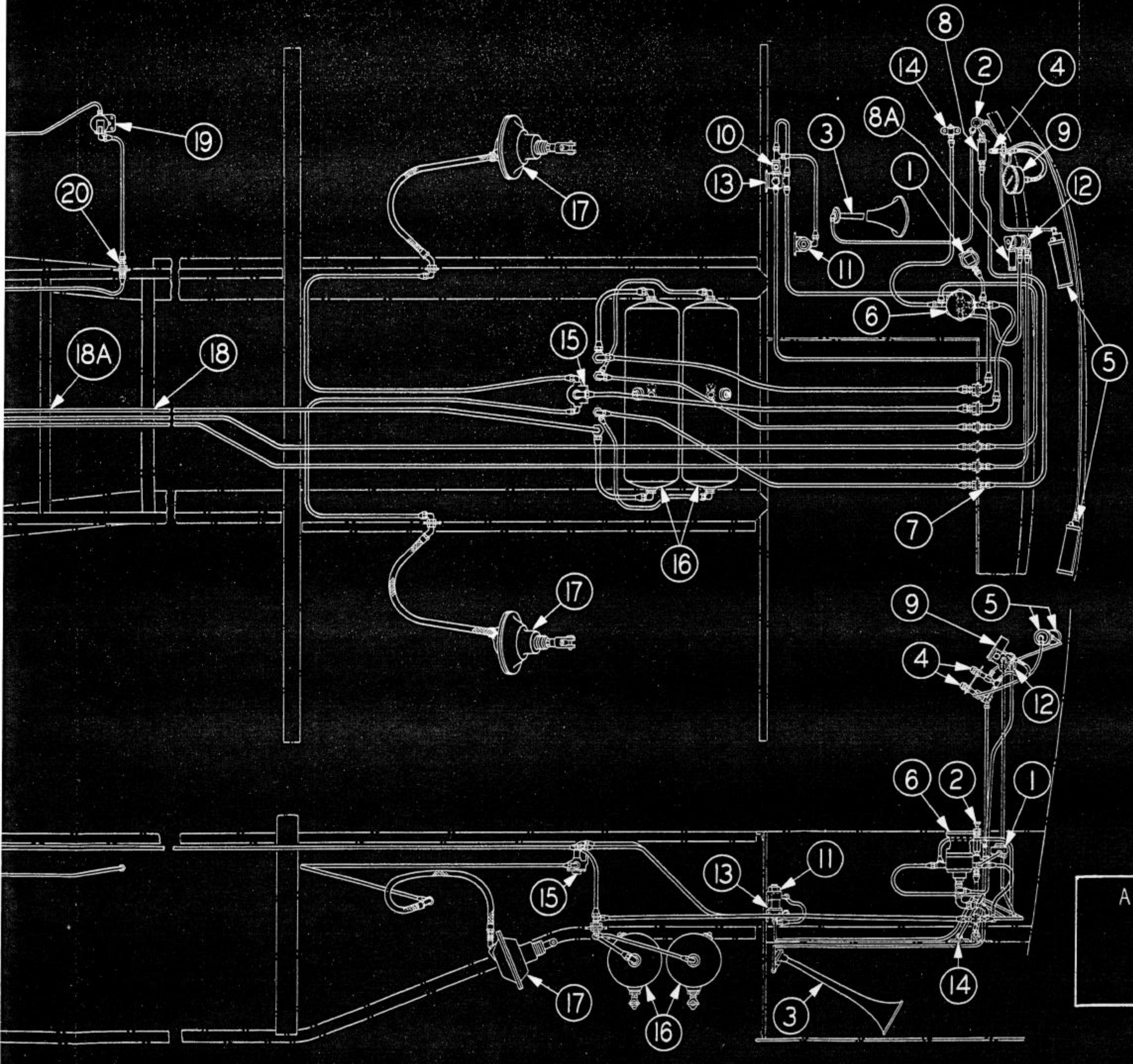


AIR LINES DIAGRAM
MODELS
PGG, PDG-37 & 41
FORM X-4031

Clutch

Instructions and Descriptions Shown in This Group Apply to Following Subjects:

Clutch Assembly
Clutch Removal
Clutch Adjustment
Specifications

Instructions Applying to Related Parts of Clutch Will be Found in Following Groups:

Name	Group No.
Engine	8.7101
Transmission	17.11101
Control Linkage	4.10401

Clutch assembly, as illustrated in Fig. 1, is single dry-disc type, manually controlled by conventional treadle type pedal through linkage to clutch assembly.

Clutch assembly is bolted directly to flywheel clutch plate which in turn is bolted to face of flywheel. Three locating dowels are fitted into flywheel plate and held in place with snap rings. The dowels which locate and align clutch assembly, fit into corresponding reamed holes in clutch cover casting.

REMOVING CLUTCH ASSEMBLY

Transmission must be removed from power plant in order to service clutch (other than minor adjustment). See "Engine" group for mounting instructions.

After transmission is removed, clutch assembly may be removed in following manner:

1. Insert six special cap screws (See Fig. 1) through cover plate in holes directly above each release lever. Screw into pressure plate as far as they will go. These cap screws remove pressure spring load so that attaching cap screws may be readily removed. These "pressure-relief" screws must be removed after assembly is reinstalled on flywheel.
2. Support clutch assembly securely as attaching cap screws are loosened. Do not allow weight of assembly to rest on dowel pins.
3. Continue to support assembly after cap screws have been removed. Tap flange of clutch with rawhide hammer. Remove assembly squarely without allowing weight of clutch to rest on dowels.

DISASSEMBLY AND SERVICE

COVER PLATE

Place entire clutch assembly in arbor press and compress slightly to release spring load. Remove "pressure-relief" cap screws as well as release lever adjusting yoke lock plates and nuts.

Before arbor press is completely released, mark relative position of cover plate on pressure plate so that they may be reassembled in same position. When pressure is completely released, cover plate may then be removed.

PRESSURE PLATE

Examine pressure plate face for checks and scores. Whenever necessary to reface pressure plate, remove just enough metal to give a smooth, flat friction surface. Grinding is preferred. However, if necessary equipment is not available, finish cut, and then polish surface with emery cloth. It is not practical to face off pressure plate more than 3/32" from original thickness.

If it should be necessary to resurface rear pressure plate to less than dimension shown in "Specifications" to clean up, new plate should be installed. Likewise, if forward pressure plate (on flywheel) must be faced down to less than dimension shown in "Specifications" to clean up, new plate should be installed.

Continued use of old plates, if thinner than dimensions given, may lead to plate distortion and clutch drag. Furthermore, excessively thin plates prevent lever yokes from engaging full length of threads in nuts.

To check thickness of spring pressure plate, place it friction face down on surface plate and use surface gauge to check distance from

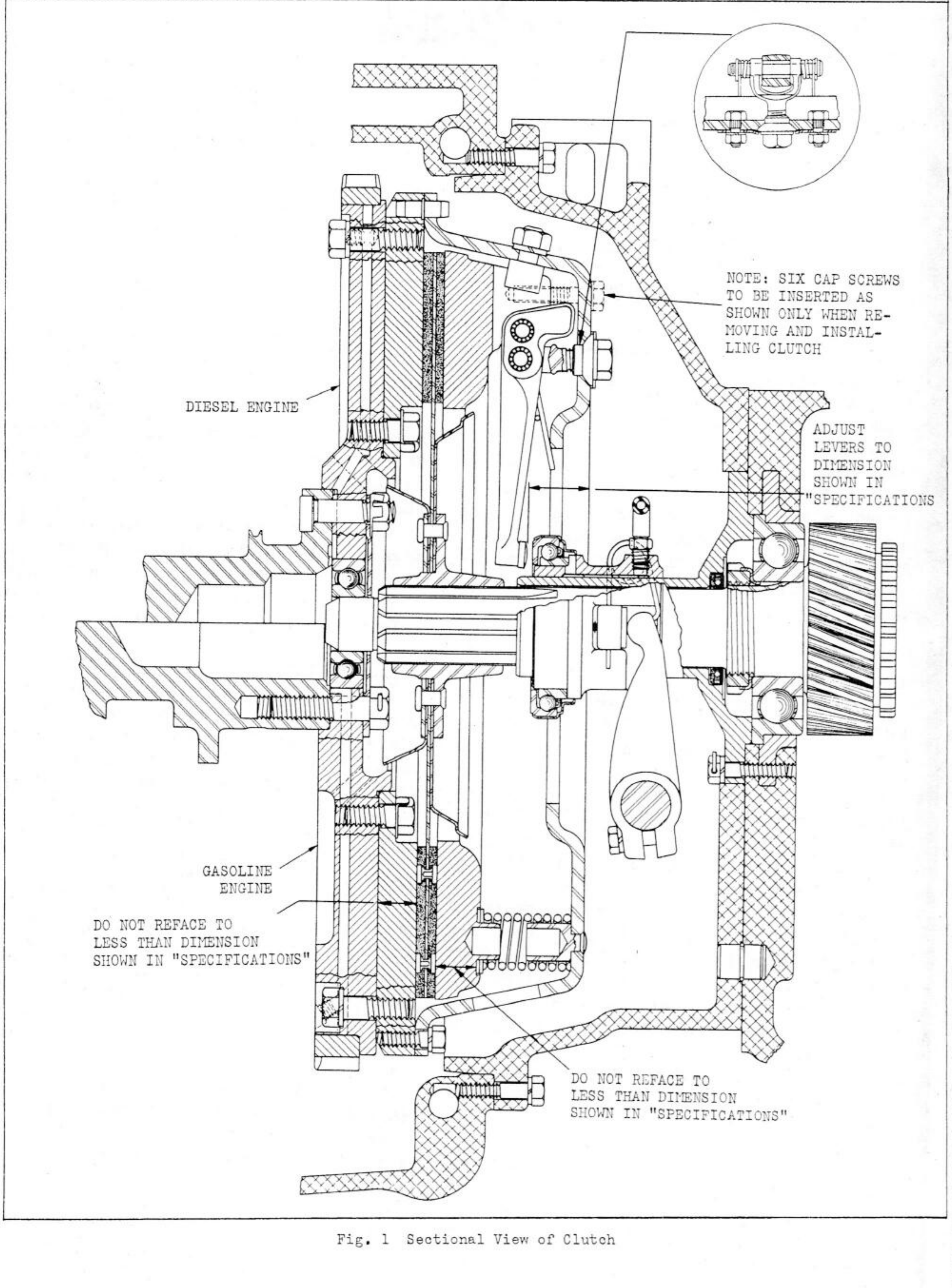

NOTE: SIX CAP SCREWS TO BE INSERTED AS SHOWN ONLY WHEN REMOVING AND INSTALLING CLUTCH
DIESEL ENGINE
ADJUST LEVERS TO DIMENSION SHOWN IN "SPECIFICATIONS"
GASOLINE ENGINE
DO NOT REFACE TO LESS THAN DIMENSION SHOWN IN "SPECIFICATIONS"
DO NOT REFACE TO LESS THAN DIMENSION SHOWN IN "SPECIFICATIONS"

Fig. 1 Sectional View of Clutch

plate to pressure spring seat. See Fig. 1. Be sure composition washers used between springs and plate are removed when checking plate thickness.

Whenever Pressure plate is refaced, special washers should be installed between pressure spring insulating washers and pressure plate as indicated in Fig. 1. These washers are 1/32" thick; therefore, one washer should be used under each spring for each 1/32" faced off.

PRESSURE SPRINGS

Pressure springs are mounted as shown in Fig. 1. Springs fit over locating bosses integral with pressure plate, and seat on plate on composition insulating washers. Retaining cups, riveted to cover plate, locate and retain springs at cover plate.

All pressure springs should be tested before installation, and should be within the limits shown in "Specifications" section.

DRIVING BLOCKS

Drive is taken by six driving blocks bolted to cover plate and registering with corresponding slotted lugs in pressure plate.

If there is indication of wear or scoring on driving blocks, loosen nuts and turn all six blocks 90 degrees, using other two sides for bearing contact.

When driving blocks are installed or turned, they must be lined up carefully to prevent bind or uneven contact with pressure plate lugs. Use pressure plate as a fixture as nuts are tightened. Pressure plate must move freely on blocks after nuts are tightened.

CLUTCH RELEASE LEVERS

The six release levers are equipped with hardened thrust buttons which contact release bearing. Each lever fulcrums and pivots on two needle type roller bearing assemblies.

If needle bearings have been removed from pressure plate, two pilot pins may be used to reassemble bearings in levers. These pins may be made from cold rolled steel, slightly shorter than length of rollers and same diameter as yoke pins. Ends of pilot pins should be well chamfered.

All fourteen rollers used in each bearing should be assembled around pilot pins in both holes of lever. Pack rollers with release bearing lubricant. See "Lubrication" section.

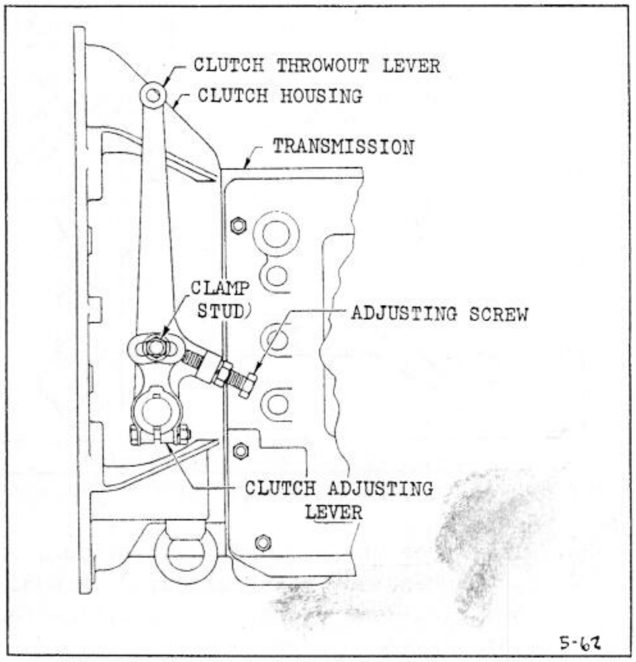


Fig. 2 Clutch is Adjusted for Wear as Shown

When both sets of rollers are assembled in lever, put lever adjusting yoke in position with lever spring straddling lever and push pilot pin out with regular pin. Same procedure should be followed when assembling lever to pressure plate lug.

If hardened thrust buttons on end of levers show wear, they can be removed readily and new buttons installed. It is not necessary to remove levers from pressure plate to install the buttons.

DRIVEN DISC ASSEMBLY

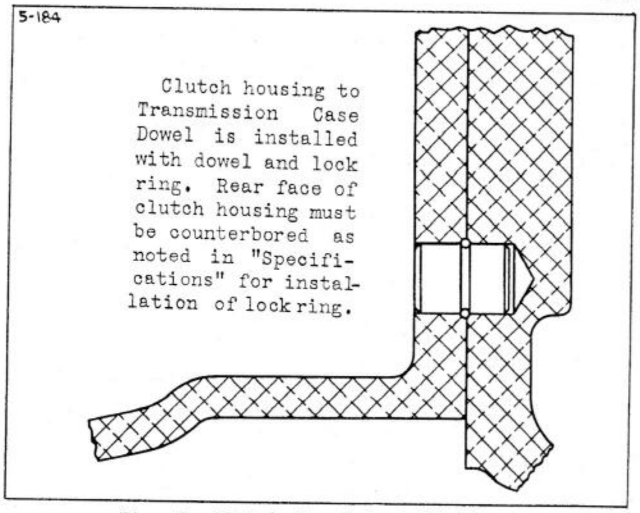
When removing facings, rivets should be drilled out, using drill slightly smaller than diameter of rivet. Support the assembly during this operation and the riveting operations, so that disc will not be sprung or distorted.

Check over-all thickness of assembly after facings are installed. Assembly should then be tested for run-out, which should not exceed maximum run-out, as shown in "Specifications", measured at point about 1-1/2" from outside edge of front lining (toward flywheel).

ASSEMBLING CLUTCH

The following steps may be taken to reassemble clutch:

1. After release levers are assembled to pressure plate, as previously explained, place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Clutch housing to Transmission Case Dowel is installed with dowel and lock ring. Rear face of clutch housing must be counterbored as noted in "Specifications" for installation of lock ring.

Fig. 3 Clutch Dowel Installation

pressure plate face down on two wooden blocks.

2. Place pressure springs in position. Before springs are reinstalled, check against specifications shown in "Specifications" section.

   IF PRESSURE PLATE HAS BEEN REFACED, install special shim washers between each pressure spring insulating washer and pressure plate. If pressure plates have been dressed down, use one washer 1/32" thick under each spring for each 1/32" removed.
3. Place cover plate over pressure springs so that driving blocks will enter slots in plates, with location marks on cover and plate in line, and spring cups on cover inside of each spring.
4. Place assembly in arbor press, and compress until ends of adjusting yokes enter corresponding holes in cover plate. To assist engaging ends of yokes in holes as assembly is further compressed, place small blocks of wood (1/4" thick) underneath inner ends of levers.
5. Compress assembly until adjusting nuts can be turned three or four threads.
6. Install temporarily pressure relief screws in cover plate and pressure plate. These screws will draw pressure plate toward cover and will hold assembly compressed. DO NOT FAIL TO REMOVE THESE SCREWS AFTER CLUTCH IS ASSEMBLED TO FLYWHEEL PLATE.

ASSEMBLING CLUTCH TO FLYWHEEL

1. Before assembling clutch assembly to flywheel, check bolts which attach clutch plate to flywheel, and flywheel to crankshaft. Clean pilot bearing thoroughly and pack with grease specified in "Lubrication" chart.
2. Inspect dowels on flywheel clutch plate. Snap rings should be renewed if they have been removed for any purpose. Do not compress snap rings any more than necessary to install. Make certain that rings fit snugly into grooves.
3. Put driven disc into plate with short end of splined hub toward flywheel. Insert a spare clutch shaft or dummy shaft through cover plate to hold assembly in alignment.
4. Install attaching screws.
5. Remove the six "pressure-relief" cap screws.
6. Put adjusting nut lock plates in position leaving their cap screws loose enough so that nuts can just be turned when adjusting levers.

ADJUSTING RELEASE LEVERS

1. Adjust release levers so that contact points on levers are dimension shown in "Specifications" (with new lining) from straight edge laid across outer face of cover plate.

ADJUSTMENT FOR WEAR

Adjustment for wear on lining is made at the linkage, Fig. 2, and NOT at release levers. With release levers adjusted as explained under "Adjusting Release Levers", linings should be worn down to rivet heads when levers touch cover plate. When this occurs, linings should be renewed and pressure plates refaced if necessary.

To adjust for lining wear, Fig. 2, turn adjusting screws so that clutch pedal has 1-1/2" free play before clutch starts to release. See "Control Linkage".

CLUTCH HOUSING

Two dowel pins, held in clutch housing with snap rings, locate clutch housing on main case. In production, the clutch housing is bolted in place with drive shaft bearing retainer in place; the dowel pin holes in both case and housing are line reamed, and dowels installed; and then a finish cut is taken on shoulder of clutch housing to align housing concentric with main shaft. See Fig. 3.

Service clutch housings are machined same manner before shipment except th holes are not reamed. Dowel holes undersize. When clutch housing with new part, bolt housing to same manner. Line ream dowel holes housing to dimension shown in "Specifications. Then ream clutch housing holes only to dimension shown in "Specifications". Install dowel pin and snap rings.

If clutch housing has been removed for other repair purposes, renew gasket between housing and case before reinstalling. Always temporarily install main drive gear bearing retainer before bolting housing to case to assist aligning housing and case.

CLUTCH SHIFTER SHAFT

The clutch shifter shaft, Fig. 4, is supported in cover on needle type roller bearings.

The vertical clutch shifter shaft, upon which is fastened clutch shifter yoke, is supported at lower end of housing with a cap and seven shims (one, .031" and six, .005"). These shims place clutch shifter yoke in proper position.

If shifter shaft is removed for any purpose, reinstall with same number of shims under lower end. After installation, check clearance between yoke fingers and bearing retainer. Free movement of bearing retainer and yoke and shaft assembly is all that is necessary. If clearance is not correct, loosen the two shift yoke screws and tap yoke lightly in direction desired. If this procedure does not obtain correct clearance, remove or install necessary shims to obtain proper clearance.

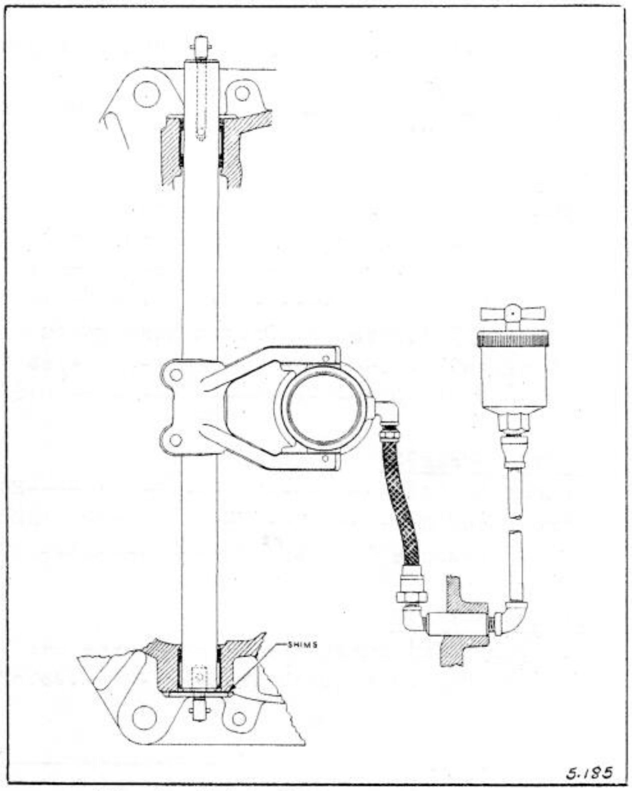


Fig. 4 Clutch Shifter Shaft and Yoke

CLUTCH CONTROL LINKAGE

As clutch control linkage (pedal to clutch proper) is closely associated with brake and accelerator linkage, illustrations and instructions regarding these parts will be found in "Fuel System" group of this book.

LUBRICATION POINTS

Following is a description of operations necessary to lubricate clutch and controls. Refer to Lubrication Chart (Group 13) for lubricant specifications and periods.

1. Clutch pedal hinge pin - two oilers, one at each end of pin - accessible through inside of coach. Use oil can.
2. Clutch cross shaft - one fitting on end of shaft - accessible through tool compartment. Use pressure gun.
3. Clutch throwout bearing - Grease cup - screw handle down one turn, refill if necessary - accessible through transmission inspection door.
4. Clutch throwout bearing cross shaft - two fittings, one at each end of shaft. Upper fitting accessible through right hand engine compartment door. Lower fitting accessible from underneath vehicle. Use pressure gun.
5. Control rod bell cranks - Three fittings with grease tubes, located at engine bulkhead - accessible from underneath vehicle. One fitting for clutch control. Use pressure gun.
6. Clutch spline - greased at assembly.
7. Clutch control linkage - accessible through tool compartment, fog lamp opening, transmission inspection door and right and lef engine compartment doors. Use pressure gun.

SPECIFICATIONS

TYPE--------------------------Single Plate

CONTROL------------------------------Manual

FACINGS

Number Used------------------------------2
Outside Diameter------------------16-3/4"
Inside Diameter-----------------------10"
Thickness---------------------.184"-.190"
Overall Thickness of Driven Disc (With Linings)---------------------------.457"
Run-Out Not Over--------------------.015"

CLUTCH SPRINGS

Quantity Used--------------------------24
Free Length-----------------------2-7/32"
Lbs. Pressure @ 1-19/32"----------134-139

PRESSURE PLATE

Original Thickness---------------------1"
Do Not Reface to Less Than---------.9375"

FLYWHEEL PLATE

Gasoline
Original Thickness-----------.880"-.870"
Do Not Reface to Less Than---.818"-.808"

Diesel
Original Thickness-----------.880"-.870"
Do Not Reface to Less Than---.818"-.870"

Adjustment
Lever Button to Cover Plate-------1-3/8"
Levers in Same Plane Within--------.030"
Pedal Play Before Releasing-------1-1/2"

Control Linkage---See "Fuel System" Group

CLUTCH HOUSING DOWELS

Line Ream Clutch Housing and Main Case To--------------------.7730"-.7745"
Counterbore Clutch Housing Rear Face only .850"-.860" Diameter, to Depth of .062"-.072"

Cooling System

Illustrations and Descriptions in This Group Apply to Following Subjects:

- Fan
- Water Pump
- Radiators
- Radiator Shutters
- Anti-Freeze Solutions
- Specifications

Instructions Applying to Related Parts of Cooling System Will be Found in Following Groups.

Group Name	Group No.	Group Name	Group No.
Generator Fan	7G.0001	Engine (Diesel)	Diesel Manual
Heating System	Air Con.Manual	Wiring Diagram	7W.0001
Engine (Gasoline)	8.7101		

Economical operation of engine and need for heating coach depend upon proper temperatures being maintained in heating and cooling system. This system will adequately control operating temperatures during severe hot or cold weather provided all units of system are properly maintained. It includes two radiators, surge tank, two fans, water pump, spring loaded water pressure valve, two shutter thermostats, alarmastat, water temperature element, heating system. Description and maintenance instructions on each unit are given in succeeding paragraphs. Heating system and Diesel cooling units are described in detail in "Air Conditioning" and "Diesel" manuals, respectively.

FANS

GENERATOR FAN

Generator fan is mounted at front end of generator and is belt-driven from crankshaft pulley. See "Generator" group in this book. It provides cooling for forward radiator and assists in ventilation of generator. Generator position can be adjusted in order to obtain correct belt deflection. Turnbuckle between engine and generator maintains proper belt tension regardless of engine movement. See "Generator" group in this book.

Removal and installation of generator fan are described in "Generator" group of this book.

CRANKSHAFT FAN

Rear radiator fan is mounted directly on crankshaft in conjunction with harmonic balancer and pulley, as shown in Fig. 1. Fan blade assembly is installed on fan hub, and air is drawn through radiator through shroud. Fan can be removed only as a complete assembly after removing set screws and fan assembly bolts.

Harmonic balancer is held to hub by six bolts, and air compressor and generator drive pulley is keyed to shaft.

In the Diesel engine, balancer is cased in housing, and fan is bolted to flange at end of shaft. Refer to "Cooling System" in the Diesel Manual.

BELT ADJUSTMENT

Crankshaft fan belt should be tightened for proper tension by loosening pulley clamp nuts and screwing outer half of pulley in or out to obtain correct belt deflection, as shown in Fig. 2. Forward radiator fan belt is adjusted to proper deflection by adjusting turnbuckle between engine and generator.

Belts should be replaced in matched sets in order to assure belts of same length.

LUBRICATION

Forward radiator fan lubrication is taken care of by generator lubrication. See 7G "Electrical" group.

Rear radiator fan is lubricated through pressure fitting easily accessible from engine compartment. Refer to "Lubrication" chart for proper lubricants to be used.

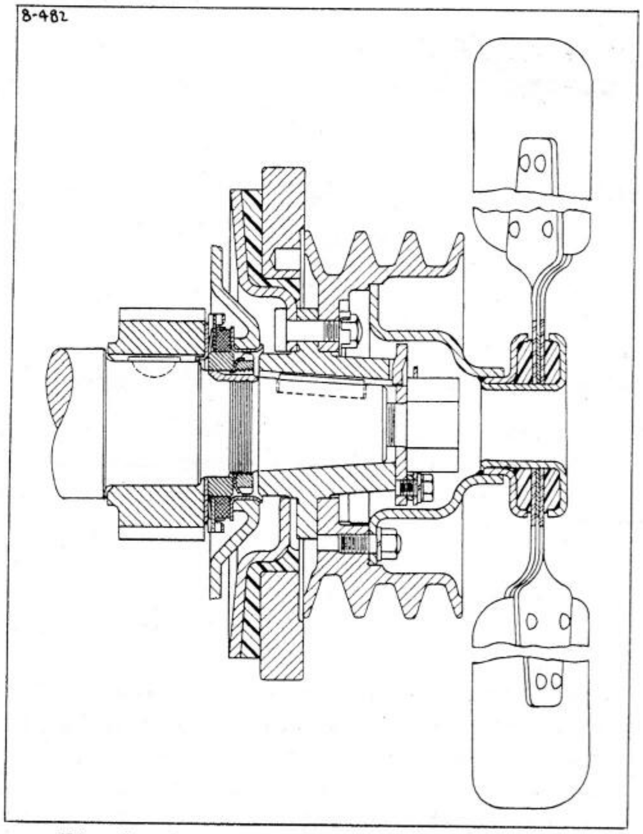


Fig. 1. Rear Fan is Mounted on Crankshaft.

WATER PUMPS

GASOLINE ENGINE WATER PUMP

Water pump assembly, Fig. 3, is mounted at lower left-hand front of engine and is driven by distributor drive shaft assembly.

Pump is "packless" type with spring loaded seal at impeller end instead of packing and gland nut.

Seal is held in contact with large carbon washer and shaft bushing by spring and clamp ring and is held in place by lockwire.

Drive shaft is mounted on double row ball bearing held in housing by lock ring, and on shaft by nut and special lock. Spring loaded oil seal contained in retainer is pressed into pump body. This seal prevents lubricant at bearing from entering water passages.

Impeller is pressed on tapered end of drive shaft and held in place with key and castle nut. Tang of drive shaft fits into slot in distributor drive shaft.

DISASSEMBLING

Entire assembly must be removed from engine before disassembling unit.

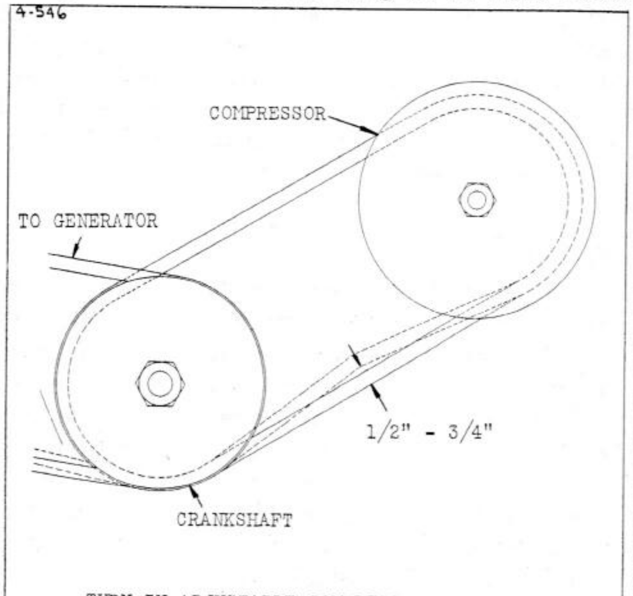
Disassemble unit in following manner:

1. After pump cover has been taken off, remove impeller.
2. Remove snap ring from impeller. This allows seal assembly to be removed.
3. Remove bearing lockwire and press shaft and bearing from body.
4. Remove oil seal and replace with new one.

ASSEMBLING

When pump is assembled, impeller seal clamp rings and lockwires should be renewed. Also renew rear bearing lockwire. Make sure impeller and rear bearing seals are in good condition.

1. Check surface on shaft where oil seal rides for smoothness. If necessary, take small grinding cut.
   Remove all corrosion and rubber from shaft. THIS IS IMPORTANT as rubber from old seal usually vulcanizes itself to shaft, making very rough surface, which will not allow new rubber to seal.
2. Inspect bearing and be sure that inner race is clamped tight on shaft.
3. Clean and inspect body, being sure drain hole is clear.
4. Replace shaft in housing and secure with bearing lockwire.
5. Before inserting new seal, place some hard grease on seal clamp ring so it will stick



TURN IN ADJUSTABLE COMPRESSOR PULLEY
TO TIGHTEN BELT

Fig. 2. Adjust Rear Fan Belt as Shown.

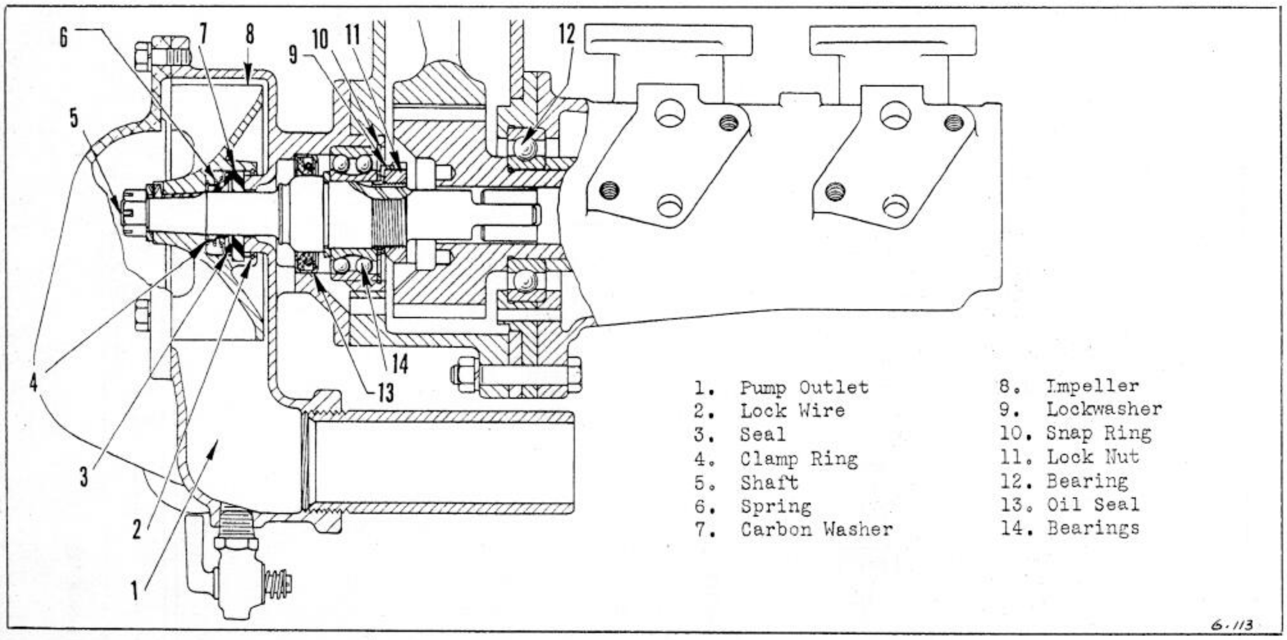


Fig. 3. Water pump used on Gasoline Engine.

to rubber insuring its location in assembly.

6. Place seal parts into impeller in following sequence:
   a. Steel spacing washer.
   b. Spring.
   c. Flexible seal with brass clamping ring stuck with grease to smaller diameter and spring guide over larger diameter.
   d. Carbon.
   e. Snap ring.
7. Inspect sealing surface on pump body, and see that it is smooth, free from pit marks and excessive wear.
8. Place few drops of lubricating oil on inside of flexible seal and on shaft and replace impeller.
9. Tighten impeller nut snugly, lock securely with cotter pin, and replace pump cover.

LUBRICATION

Ball bearing is lubricated by engine oil through timing gear housing.

DIESEL WATER PUMP & OIL COOLER

Refer to separate operating manual on Diesel Engines for water pump and oil cooler used on these vehicles.

HEAT INDICATORS

The "alarmastat" system, circuit of which is illustrated in Wiring Diagram, comprises thermal unit installed in engine water passage and electrically connected to a buzzer located near driver.

When temperature of cooling system reaches a dangerous degree, action of thermal unit completes electrical circuit to buzzer which continues to sound until ignition switch is turned off.

When buzzer sounds, engine should be immediately stopped, and condition which caused overheating should be located and remedied.

WATER TEMPERATURE

Electric temperature gauge which gives direct reading at instrument panel gauge as soon as ignition is turned on, is used.

Thermostatic temperature plug is used at right end of top water manifold, which transmits temperature to gauge at instrument panel. Wiring circuit is illustrated in Wiring Diagram. See group 7W.0001.

AIR CIRCULATION

Air is drawn through forward and rear radiator by large blade fans through shroud, mounted inside of each radiator. Radiator shrouds and shutters, are arranged so that most of air leaving fan is immediately exhausted from engine compartment. Some air, however, is permitted to pass over manifold

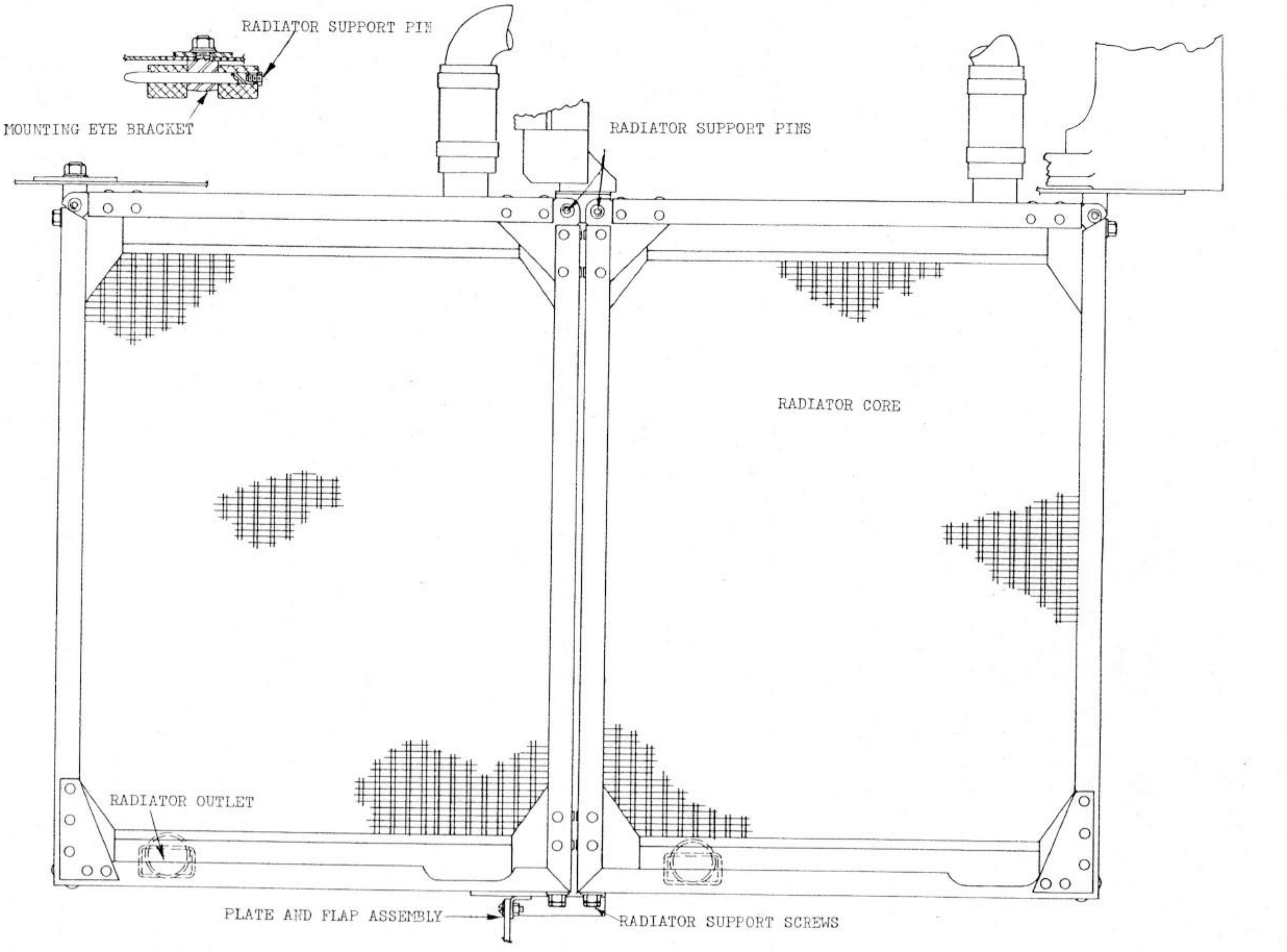


Fig. 4. Radiator Mounting.

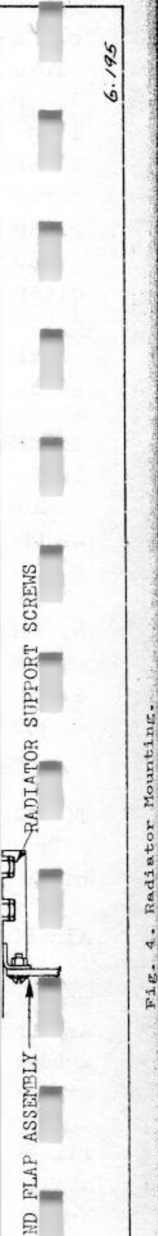


Fig. 4. Radiator Mounting.

and accessories. With this arrangement, the minimum road dust enters the engine compartment.

WATER CIRCULATION

A spring loaded water pressure valve provides proper maintenance of engine temperature throughout the year.

This valve provides for circulation of water through heater lines and permits sufficient by-pass into radiator to maintain proper engine and heater temperatures according to the predetermined pressure.

In order to maintain proper circulation of water in cooling system, various service operations outlined in this section should be followed closely. The essential services include, maintaining proper level of cooling liquid; keeping fan belts at proper tension; taking necessary steps to prevent water passages becoming clogged with sediment and scale.

RADIATORS AND SURGE TANK

Radiators are mounted on left side of coach in front of engine and generator, and are held securely in position by four top radiator support pins installed in mounting eye bolted to body (Fig. 4). Forward and rear radiators are held together at the bottom by means of a center plate. Radiator support pins lock when mounting eye bolts are tightened up.

Cylindrical surge tank, clamped in upper left section of engine compartment bulkhead, permits expansion of cooling liquid without loss from overflow. Overflow tube of radiator enters at bottom of surge tank.

Excessive liquid in surge tank is taken out through top tube which extends from surge tank down side of radiator core.

The radiator is designed to cool the water under all operating conditions; however, radiator cores must be kept free from corrosion and scale at all times, in addition to the maintenance of other cooling units, to obtain satisfactory service. Cleaning of radiators, inspection of connections, mounting bolts and pins, and use of corrosion preventives are essential periodic service procedures.

Radiator cores should be periodically cleaned inside and out in a cleaning solution. At the same time, examine core for leaks and bent tubes, and repair if necessary. If radiator core requires painting, spray with special radiator paint. Do not use paint mixed with oil, as this type will form an insulation on core and prevent dissipation of heat.

If necessary to remove radiator cores for repair operations when power plant is in chassis, proceed as follows:

REMOVING RADIATORS

1. Remove radiator shutter door. See instructions on page 7 of this group.
2. Drain radiators.
3. Disconnect top and bottom hose connections. Forward radiator top hose connection is disconnected by removing rear cross seat corner hand hole cover plate. This is accomplished by turning two cover plate fasteners one quarter turn.
4. Remove two lower radiator support plate and flap assembly screws at bottom of radiators.
5. Release mounting eye brackets by loosening mounting eye bolts. (Forward radiator front mounting eye bolt can only be reached after removing emergency door step plate, which is accomplished by removing step plate screws). This will unlock radiator support pins.
6. Place lifting jack under radiator being removed.
7. Insert cap screw into radiator support pin threaded holes and use as pullers to remove pins.
8. Lower jack and force radiator down until top water pipe will clear body.
9. Pull radiator outward from bottom.

TO REMOVE CORE FROM FRAME

1. Remove three frame bolts, diagonally opposite.
2. Lift radiator core.

When assembling core, make sure rubber pads are properly installed on all four sides of frame.

RADIATOR SHUTTERS

Radiator shutters automatically controlled, as shown in Fig. 5, regulate operating temperature in cooling system.

Shutter thermostats in thermostat casting, between surge tank and rear radiator, are controlled by air valve in radiator connec-

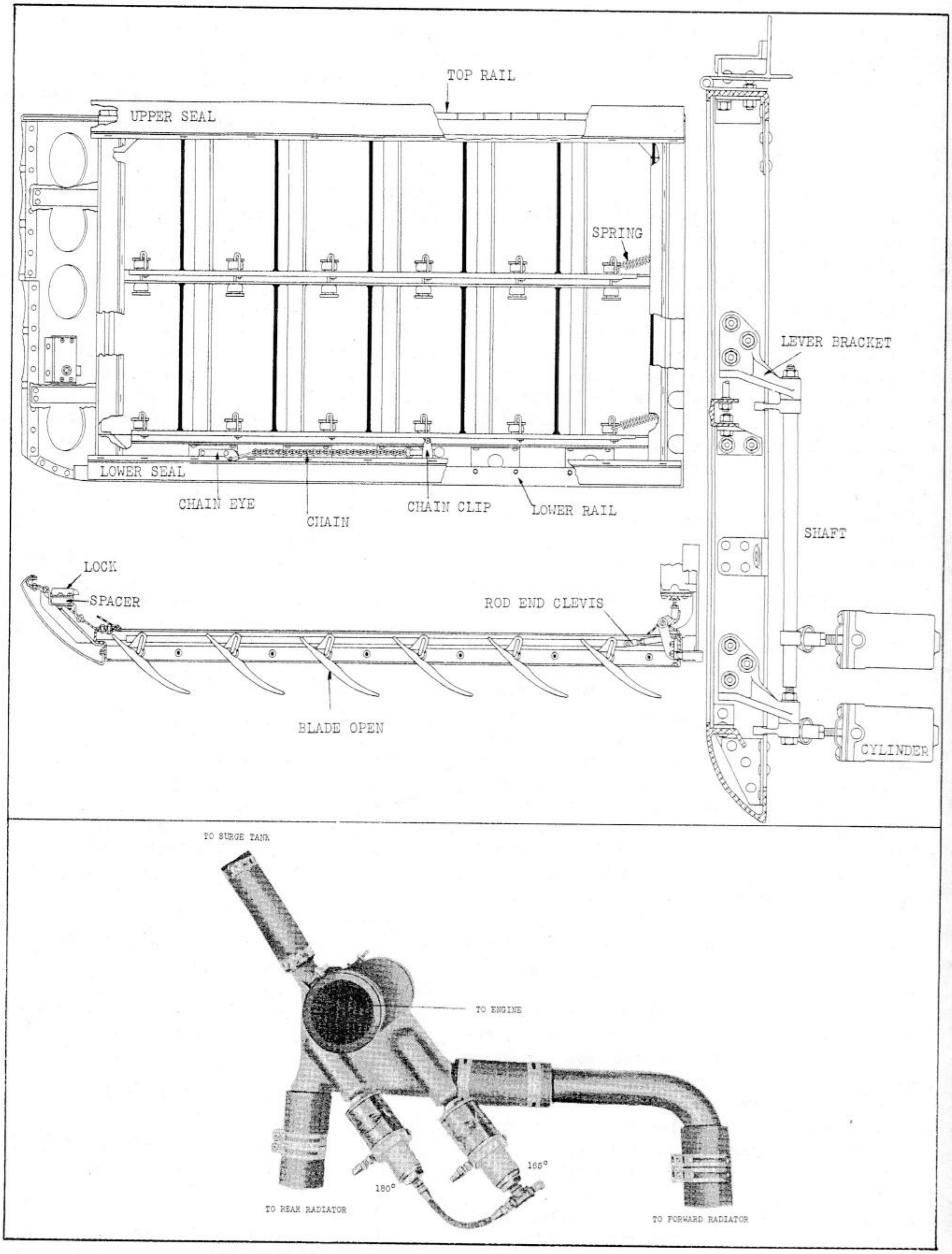


Fig. 5 Radiator Shutter Mounting and Shutter Thermostats

tions and actuate air cylinders in lower front of forward radiator, which in turn open or close shutter blade assemblies. Upper and lower radiator shutter thermostats, controlling upper and lower shutter blade assemblies, are set to open and close at temperatures shown in "Specifications" at end of this group.

Shutter vane bearings and linkage should be cleaned periodically and all accumulation of dust and other foreign matter removed. Oil should be used sparingly on shutter, as an excessive amount will collect dirt rapidly.

TO OPEN RADIATOR SHUTTER DOOR

1. Shut off stop cock at top of air filter, located above surge tank (Fig. 6).
2. Open drain cock at bottom of filter to bleed air. Shutter blades are then opened actuated by tension of blade springs.
3. Remove shutter door locking cap screw thru lower front blade opening.
4. Using proper socket key, unlock forward and rear end of shutter door, and open door.

TO REMOVE SHUTTER DOOR

Proceed as above, then remove shutter door hinge blade screws and remove shutter door.

AIR FILTER

Air filter, shown in Fig. 6, prevents moisture from entering shutter thermostats. As air from air tank enters filter, it strikes against baffle which diverts moisture in air stream to bottom of housing. Air then passes through felt filtering element. Air is again filtered through felt before entering thermostatic air valves. Periodic check should be made for leakage at strainer connections, and tighten if necessary. Air filter fluid chamber is filled at factory. With felt inserted, chamber holds slightly over one ounce of fluid.

AIR FILTER MAINTENANCE

Air filter should be drained every week by opening pit cock at bottom; daily during winter months. This operation should be performed under pressure.

Every 10,000 miles, air filter should be disassembled and the felt cleaned with gasoline or replaced.

Thermostat inlet line should be disconnected every 5,000 miles and a tablespoonful of alcohol injected. When air line is reconnected, pressure will force alcohol through needle valve and clean away any deposits of foreign matter.

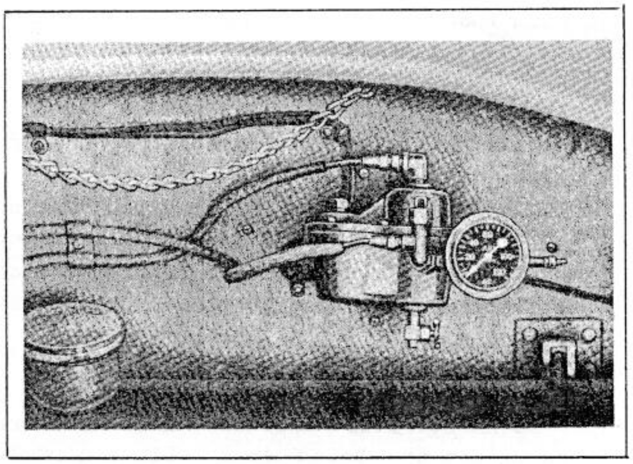


Fig. 6. Air Filter is Mounted as Shown.

Air cylinder pipe plug, Fig. 5, should be removed every 5,000 miles and two tablespoonsful of castor oil injected. Piston should be removed, cleaned and inspected every 20,000 miles. Add castor oil when reassembling.

CLEANING RADIATORS AND COOLING SYSTEM

Radiators and cooling system should be cleaned and flushed at least twice a year, particularly before using anti-freeze solutions.

Unless water in cooling system is treated with a corrosion preventive, rust and scale may clog up water passages in both radiators and water jacket. This condition is aggravated in some localities by formation of insoluble salts from the water used.

Cleaning solutions commercially available, such as "Rex" (available at all GMC Service Stations) will successfully clean cooling systems of rust, scale, sludge and grease if used as directed by the manufacturers. However, if radiators are clogged with insoluble salt formations, reliable radiator service stations in the various localities are best equipped to remove such formation. These service stations should be familiar with local conditions and are in a position to apply proper treatment.

Particularly at winter check-up, radiators and system should be cleaned with "Rex" cleaning solution. Drain radiators and fill with solution as directed. With radiators covered and filler cap installed, run engine at medium speed. Drain radiators and pressure-flush system with clean water.

INSPECTION OF COOLING SYSTEM

Make the following inspections at regular intervals:

1. Check all water connections. Hose connections should be in good condition inside and out. Tighten hose clamps if necessary.
2. Inspect water pump, cylinder head gaskets and connecting gaskets for leaks.

FILLING RADIATORS

Do not overfill radiators while anti-freeze solutions are being used. Since normal expansion of water causes level in radiator to rise, appreciable amount of liquid will be lost through overflow pipe. When engine is cold, contraction of liquid lowers water level, and it is this apparently low level which leads to the belief that additional water is necessary. However, if radiators are filled to overflow level every time engine cools down, anti-freeze solutions will be entirely lost in a very few days.

CAUTION: When checking water level in radiators, do not add water if cooling is visible through filler neck after engine is thoroughly warmed up. Never fill radiators to overflow level while anti-freeze solutions are in use.

INHIBITORS

The treatment of cooling systems for prevention of scale and rust formation has become an accepted automotive maintenance practice. This process consists of introducing into the cooling system certain substances which reduce or prevent corrosion of metals and deposition of scale, thus tending to maintain high cooling system efficiency.

In general, inhibitors are not cleaners and will not remove scale and rust already formed. Inhibitors should be used continuously. It is advisable to use an inhibitor immediately after the system has been thoroughly cleaned or when the vehicle is new.

In no case should inhibitor be added when anti-freeze solution already contains an inhibitor, as an excessive amount may be harmful to rubber parts.

Following are the salient points concerning the recommended inhibitors:

1. GMC-PH7

Use only in plain water and in anti-freeze solutions which are not treated with an inhibitor. GMC-PH7 is very effective in preventing corrosion of any metal found in the cooling system. It can be purchased at any GMC Service Station and is recommended for all vehicles in summer or in winter.

2. SOLUBLE OIL

Use only in plain water and in anti-freeze solutions which do not contain inhibitor, in accordance with instructions issued by the soluble oil manufacturers. Supply stations have available various soluble oil inhibitors. These are marketed under different names, but generally their characteristics are similar.

When using soluble oil in plain water, or in inhibited alcohol or methanol solutions, 1/2 PINT WILL BE SUFFICIENT.

Addition of this oil turns solution milky white, but clears up as it is distributed through cooling system. Excessive amounts of soluble oil are undesirable -- do not add too much. The amount of oil in a cooling system should never exceed 1% of the volume of the system.

3. POTASSIUM BICHROMATE

Use only in plain water in proportion of two ounces of crystals to each five gallons of water.

Potassium bichromate (dichromate) may be purchased from any drug or chemical house or under a trade name at supply stations.

ANTI-FREEZE SOLUTIONS

Selection of adequate anti-freeze solution for winter operation depends largely upon local conditions and type of service. Following information will assist in selecting anti-freeze solution best suited to meet individual driving conditions.

The most commonly used commercial materials are:

Denatured (ethyl) alcohol
Methanol (methyl or wood alcohol)
Propanol
Ethylene Glycol
Distilled Glycerine

Kerosene or other oils, or solutions containing calcium chloride, magnesium chloride, sodium silicate or other inorganic salts, honey, glucose or sugar, are not satisfactory for use in cooling system.

ALCOHOL AND METHANOL

Denatured alcohol and methanol are used extensively for anti-freeze solutions. Alcohol anti-freeze solutions have the advantage of low first cost.

There are, however, two important disadvantages: (1) Alcohol may be lost by evaporation, especially on warm days and on hard driving, and unless solution in radiator is tested periodically and sufficient alcohol added to replace loss, engine or radiator, or both, are liable to be damaged by subsequent freezing. (2) Coach finish is softened and damaged by contact with alcohol solutions or vapors. Alcohol accidentally spilled on finish should be flushed off immediately with large quantity of cold water without wiping or rubbing.

Surge tank, connected to overflow pipe, serves to condense and trap some of the vapor or liquid that would otherwise be lost. On cooling, condensate or liquid is returned to radiator. Surge tank is particularly useful when alcohol anti-freeze is used and especially in territories where atmospheric temperatures fluctuate over a wide range during winter months.

ETHYLENE GLYCOL

Ethylene glycol's first cost is higher than that of alcohol. Ethylene glycol solutions, however, have the advantage of a higher boiling point than alcohol anti-freeze solutions; consequently, they may be used at higher temperatures without loss, resulting in more effective performance of heating system.

Ethylene glycol has the further advantage that in a tight system only water is required to replace evaporation losses. However, losses through leakage or foaming must be replaced by additional new solution. Under ordinary conditions. ethylene glycol solutions are not injurious to body finish.

"GM Ethylene Glycol" is especially treated and compounded for use in cooling system. Other ethylene glycol preparations are available, but only those containing suitable corrosion inhibitors and compounded for use in automobile cooling systems should be used, diluting them in accord with instructions issued by manufacturer.

Frequent inspection and test should be made for accidental leakage. If solution becomes brown or rusty colored, occurrence of corrosion is indicated and the solution should be immediately discarded and replaced with fresh solution.

GLYCERINE

Radiator glycerine, chemically treated in accord with formula approved by Glycerine Producers' Association to avoid corrosion, is satisfactory for use in cooling system.

SERVICING COOLING SYSTEM

Before installing anti-freeze solution, cooling system should be inspected and serviced for winter operation. System should be thoroughly cleaned and all loose scale and iron rust removed.

Whenever cooling system is drained, be sure cylinder block, as well as radiator, is empty. Drain cocks are provided at bottom of radiator and on side of cylinder block.

Cylinder head gaskets should be tightened, or replaced if necessary, to avoid possibility of anti-freeze solution leaking into engine and exhaust gas blowing into cooling system. Anti-freeze or water mixed with engine oil will form sludge, which may interfere with lubrication and cause gumming and sticking of moving parts.

It may be advisable to install new radiator and heater hose, especially when ethylene or glycerine anti-freeze solutions are to be used. Ethylene glycol and glycerine have a tendency to shrink rubber that previously has been swollen by the absorption of water, and leaks may develop.

Water pump seal must be leak tight, not only to avoid loss of liquid, but to prevent air from being drawn into cooling system, which may cause foaming and promote oxidation and serious corrosion.

After anti-freeze solution has been installed, entire system should be inspected regularly to insure against development of leaks.

Use of additional rust preventives or inhibitors is not recommended with "GM Anti-Freeze", "GM Ethylene Glycol", or other anti-freeze preparations chemically treated or compounded for use in automotive cooling systems.

LOSS OF ANTI-FREEZE SOLUTIONS

Anti-freeze or water, or both, may be lost from cooling system through leaks, evaporation, boiling, foaming, or expansion. Loss through excessive evaporation or boiling may be caused by impaired circulation or use of alcohol or methanol only.

Loss by expansion is a result of overfilling. Average anti-freeze solution expands on heating from 30 to 100° F., and corresponding space should be left when adding liquid to cooling system. Surge tank should be kept half full at the most.

A hydrometer test will indicate whether or not anti-freeze should be added to bring solution to desired freezing point.

TESTING

Some devices, used for testing anti-freeze solutions will indicate correct freezing point only when test is made at a specific temperature. Other testers, provided with thermometers and tables, indicate freezing points corresponding to readings made at various temperatures. Disregarding temperature of solution being tested may cause an error in freezing point of as large as 30° F.

Some testing devices are made for only one kind of anti-freeze solution. Others have several scales and may be used for corresponding kinds of anti-freeze.

THE SAME HYDROMETER SCALE CANNOT BE USED FOR BOTH DENATURED ALCOHOL AND METHANOL.

It is important to have anti-freeze tested by an attendant who is familiar with proper method of testing various solutions.

The following tables show the quarts of various anti-freezes required for addition to cooling system in order to produce cooling system solutions which will not freeze above temperatures shown:

MODEL PGG-37

68 Quarts Capacity
(Including Heating)

Temperature	Alcohol	Methanol	Ethylene Glycol
+ 10°F	21	17	17
0°F	25	21	23
- 10°F	30	25	27
- 20°F	34	30	30
- 30°F	42	34	33

MODEL PDG-37

63-1/2 Quarts Capacity
(Including Heating)

Temperature	Alcohol	Methanol	Ethylene Glycol
+ 10°F	20	16	16
0°F	24	20	21
- 10°F	28	24	24
- 20°F	32	28	28
- 30°F	40	32	30

MODEL PGG-41

69 Quarts Capacity
(Including Heating)

Temperature	Alcohol	Methanol	Ethylene Glycol
+ 10°F	22	17	17
0°F	26	21.5	23
- 10°F	30	26	27
- 20°F	35	30	30
- 30°F	43	34	32

MODEL PDG-41

64-1/2 Quarts Capacity
(Including Heating)

Temperature	Alcohol	Methanol	Ethylene Glycol
+ 10°F	20	16	16
0°F	24	20	22
- 10°F	28	24	25
- 20°F	32	28	28
- 30°F	40	32	31

Other alcohol or ethylene glycol anti-freezes should be diluted in accord with instructions issued by manufacturer.

WINTER THERMOSTAT

A winter thermostat is installed for winter operation at center of hose between radiator core and engine. Winter thermostat spring is assembled toward engine. Thermostat starts to open at 180°.

Winter thermostat installation requires removal of forward (generator) radiator fan blade assembly and it must be removed for summer operation, and generator fan blade assembly reinstalled.

Wiring

Instructions and Illustrations in this Group Apply to Following Subjects:

Engine Compartment Plug		Junction Panel
Instrument Panel		Wiring
	Fuse Panel	

Instructions Applying to Related Parts of Wiring will be found in Following Groups:

Name	Group
Starting Motor	7S.0001
Distributor	7D.0001
Generator	7G.0001
Lighting	7L.0001
Miscellaneous Electrical	7M.0001

The wiring diagram immediately following this group shows all electrical circuits in this vehicle with the exception of air conditioning. Air conditioning wiring diagram is illustrated in separate air conditioning manual.

Units on wiring diagram are numbered and these numbers are keyed in tabulation shown on page just preceeding the diagram. This tabulation shows location of items as well as reference to number of groups in which they are described and illustrated.

The wiring diagram shows all circuits for both gasoline and Diesel engines with exceptions and differences plainly noted.

The main chassis wiring harness extends from junction panel (behind switch and fuse panel) to engine compartment bulkhead through air conditioning duct under floor of vehicle. The harness is enclosed in metal conduit from engine compartment bulkhead to control box compartment at right hand of engine compartment.

The body circuit harness extends from instrument panel junction to body junction panel located immediately above driver's window. Interior lighting harness from body junction panel extends along upper edge of package racks on both sides. Indirect and reading lights are tapped from this harness.

ENGINE COMPARTMENT PLUGS

Engine compartment plug, located on right hand side of engine compartment, is a two piece plug. The male or engine compartment section plugs into a section mounted at control box. The arrow on male section must be at rear when connected. Tabulation is shown on page 7W.0002.

BUZZER RELAY PANEL

Buzzer relay panel (item 60 on Wiring Diagram) is mounted behind switch and fuse panel. It is necessary to drop switch and fuse panel to gain access to buzzer relay panel. Units on the panel, Fig. 1, are temperature buzzer, passenger buzzer, stop light relay, oil gauge resistance unit.

INSTRUMENT PANEL

Instrument panel is mounted at left of driver and includes following instruments and units:

Unit	Refer to Group No.
Cooling Crank Light	Air Conditioning Manual
Air Pressure Gauge	4.10401
Speedometer	7M.0001
Oil Gauge	8.7101
Charge Indicator	7G.0001
Temperature Gauge	6.7701
Choke Switch (Gasoline)	12.8901
Stop Switch (Diesel)	(Diesel Manual)
Head Tell-Tale	7L.0001
Stop Tell-Tale	7L.0001
Emergency Door Tell-Tale	3.1701
Low Air Tell-Tale	4.10401
Starting Switch and Fuse Panel	7S.0001

SWITCH JUNCTION PANEL

Switch and fuse panel illustrated in group 7L.0001 is mounted on dash slightly to right of driver. Switch plate and fuse panel are concealed with individual sliding panels. Functions of the switches are explained in group 7L-0001. Tabulations are shown on page 7W-0003.

BODY JUNCTION PANEL

Body junction panel (item 38 on Wiring Diagram) is located just above driver's window. This junction panel is concealed by a removable panel. Body junction panel tabulations are shown on page 7W-0004.

ELECTRIC HORN

Electric horn is mounted in a horn compartment (lower left front corner of body) and is controlled by button located on steering wheel. Electrical circuit is illustrated on Wiring Diagram.

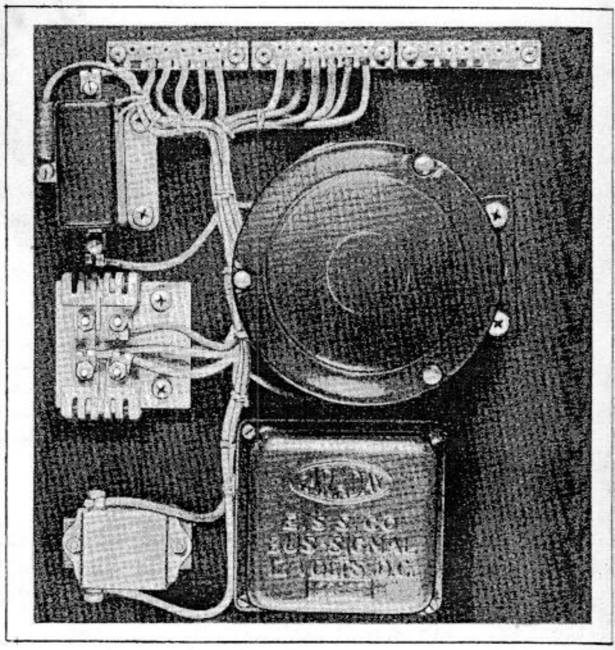


Fig. 1 Buzzer and Relay Panel

ENGINE COMPARTMENT PLUG - DIESEL

(Item 21 on Diagram)

	CIRCUIT	WIRE SIZE AND COLOR
1	Emergency Stop	#14 - Green
2	Spare	#14 - Tan - Black - Red Tracer
3	Starter	#12 - Red
4	Alarmastat	#16 - Yellow
5	Engine Stop	#14 - White - Green Tracer
6	Temperature Gauge	#14 - Yellow - Blue Tracer
7	Oil Gauge	#14 - Yellow

ENGINE COMPARTMENT PLUG - GASOLINE

(Item 21A on Diagram)

1	#1 Ignition	#14 - Green
2	#2 Ignition	#14 - Tan - Black - Red Tracer
3	Starter Solenoid	#12 - Red
4	Alarmastat	#16 - Yellow
5	Choke	#14 - White - Green Tracer
6	Temperature Gauge	#14 - Yellow - Blue Tracer
7	Oil Gauge	#14 - Yellow

WIRING

FUSE PANEL

NO.	CIRCUIT		WIRE SIZE AND COLOR
1 to 6	See Air Conditioning Manual		
7	Feed to Fog Light Switch	(15 Amp. Fuse)	#12 - Green
8	Feed to Spot Light	(15 Amp. Fuse)	Spot Light Wire
8	Feed to Defroster Fans		#14 - White
8	Feed to Baggage Compartment Lights		#14 - Green-Black Check
9	Feed to Stop Light Relay	(6 Amp. Fuse)	#16 - Green
10	Feed to Direct Switch	(3 Amp. Fuse)	#14 - Green-Black Check
11	Feed to Horn	(15 Amp. Fuse)	#14 - Black-Tan-Red Tracer
12	Feed to Head Dimmer	(20 Amp. Fuse)	#12 - Black-Tan-Red Tracer
13	Feed to R. Head High Beam	(10 Amp. Fuse)	#14 - White-Black Tracer
14	Feed to L. Head High Beam	(10 Amp. Fuse)	#14 - White-Black Tracer
15	Feed to R. Head Low Beam	(10 Amp. Fuse)	#16 - White-Green Tracer
16	Feed to L. Head Low Beam	(10 Amp. Fuse)	#16 - White-Green Tracer
17	Feed to Front Markers	(10 Amp. Fuse)	#14 - Green
18	Feed to R. Markers, Tail, Dash and Highway Signs	(15 Amp. Fuse)	#14 - Black-Green Tracer
19	Feed to R. Michigan Marker	(6 Amp. Fuse)	#16 - Red
20	Feed to Front Michigan Marker	(6 Amp. Fuse)	#16 - Black-Red Check
21	Feed to Clearance Lights	(10 Amp. Fuse)	#14 - Blue
22	Feed to Destination Sign	(10 Amp. Fuse)	#14 - Black-Tan Tracer
23	Feed to Step Light	(6 Amp. Fuse)	#16 - Yellow
24	Feed to Reading Lights (1,3,5,7,9, 11 on "All" Switch)	(30 Amp. Fuse)	#10 - Tan-Black-Red Tracer
25	Feed to Reading Lights (1,3,5,7,9, 11 on "Indv" Switch)	(30 Amp. Fuse)	#10 - Red
26	Feed to Reading Lights (2,4,6,8,10, on "All" Switch)	(30 Amp. Fuse)	#10 - Green
27	Feed to Reading Lights (2,4,6,8,10, "Indv" Switch)	(30 Amp. Fuse)	#10 - Yellow
28	Feed to Indirect Lights (1,3,5,7, 9,11,13)	(20 Amp. Fuse)	#12 - Tan-Black-Red Tracer
29	Feed to Indirect Lights (2,4,6,8, 10,12)	(20 Amp. Fuse)	#12 - Black-Green Tracer
30	Feed to Low Air Sw., Emerg. Door and Engine Buzzer	(10 Amp. Fuse)	#12 - Red
31	Feed to Oil Gauge Resistance Unit	(10 Amp. Fuse)	#12 - Red
32	Feed to Passenger Buzzer, Speedometer and No. 32 Junction	(10 Amp. Fuse)	#12 - Red

BUS FEED TO

Refer to Air Conditioning Manual for Bus feeds 1,2,3,4,5 and 6	
8,9,10,11 - Fuse	#12 - Red-Yellow Tracer
13,14 - Fuse	#12 - Yellow-Black Tracer
15,16 - Fuse	#12 - Yellow
30,31,32 - Fuse	#12 - Red
Main Fuse (In Control Box Compartment)	150 Amp.
Fuse Block in Control Box Compartment	Two - 20 Amp.
Speedometer Drive Fuse	6 Amp.

WIRING

FUSE PANEL (CONTINUED)

CIRCUIT		WIRE SIZE AND COLOR
SWITCH PANEL WIRE TABULATION		
Head Light Switch	Feed to #12 Fuse	#12 - Red-White Tracer
Fog Light Switch	Feed to # 7 Fuse	#12 - Yellow-Black Tracer
Front Markers	Feed to #17 Fuse	#14 - Green
Rear Markers	Feed to #18 Fuse	#14 - Black-Green Tracer
Front Michigan Marker	Feed to #20 Fuse	#16 - Red-Black Check
Rear Michigan Marker	Feed to #19 Fuse	#16 - Red
Clearance Lights	Feed to #21 Fuse	#14 - White
Sign (Destination)	Feed to #22 Fuse	#14 - Black-Tan Tracer
Reading Lights (All)	Feed to #24 Fuse	#10 - Tan-Black-RedxTracer
Reading Lights (Individual)	Feed to #25 Fuse	#10 - Red
Reading Lights (All)	Feed to #26 Fuse	#10 - Green
Reading Lights (Individual	Feed to #27 Fuse	#10 - Yellow
Indirect Lights	Feed to #28 Fuse	#12 - Tan-Black-RedxTracer
Indirect Lights	Feed to #29 Fuse	#12 - Black-Green Tracer
Step	Feed to #23 Fuse	#16 - Yellow

JUNCTION PANEL TABULATION

NO	CIRCUIT	WIRE SIZE AND COLOR
	Refer to Air Conditioning Manual for Junction Panel Tabulations Below #21	
21	Stop Light Switch Wire	#16 - Red
22	Starter Button	#14 - Red
23	Ignition or Emergency Stop	#14 - Green
24	Choke or Engine Stop	#14 - White-Green Tracer
25	Low Air	#16 - Blue-Yellow Tracer
26	Emergency Door Tell-Tale	#16 - Black-Red Tracer
27	Oil Gauge	#14 - Yellow
28	Temperature	#14 - Yellow-Blue Tracer
29	Passenger Buzzer	#16 - Packard
30	Baggage Compartment	#14 - Green-Black Check
31	Engine Buzzer	#16 - Yellow
32	Speedometer	#14 - Green-White Tracer

BODY JUNCTION PANEL

(Item 38 on Diagram)

NO	CIRCUIT	WIRE SIZE AND COLOR
1	Front and Side Destination Sign, Night Light, and Front	#14 - Black-Tan Tracer
3	Front Marker Lights	#16 - Red
3	Reading Lights (1,3,5,7,9,11, on "All" Switch)	#12 - Tan-Black-Red Tracer
4	Reading Lights (1,3,5,7,9,11, on "Ind" Switch)	#12 - Red
5	Reading Lights (2,4,6,8,10, on "All" Switch)	#12 - Green

WIRING

BODY JUNCTION PANEL (CONTINUED)

(Item 38 on Diagram)

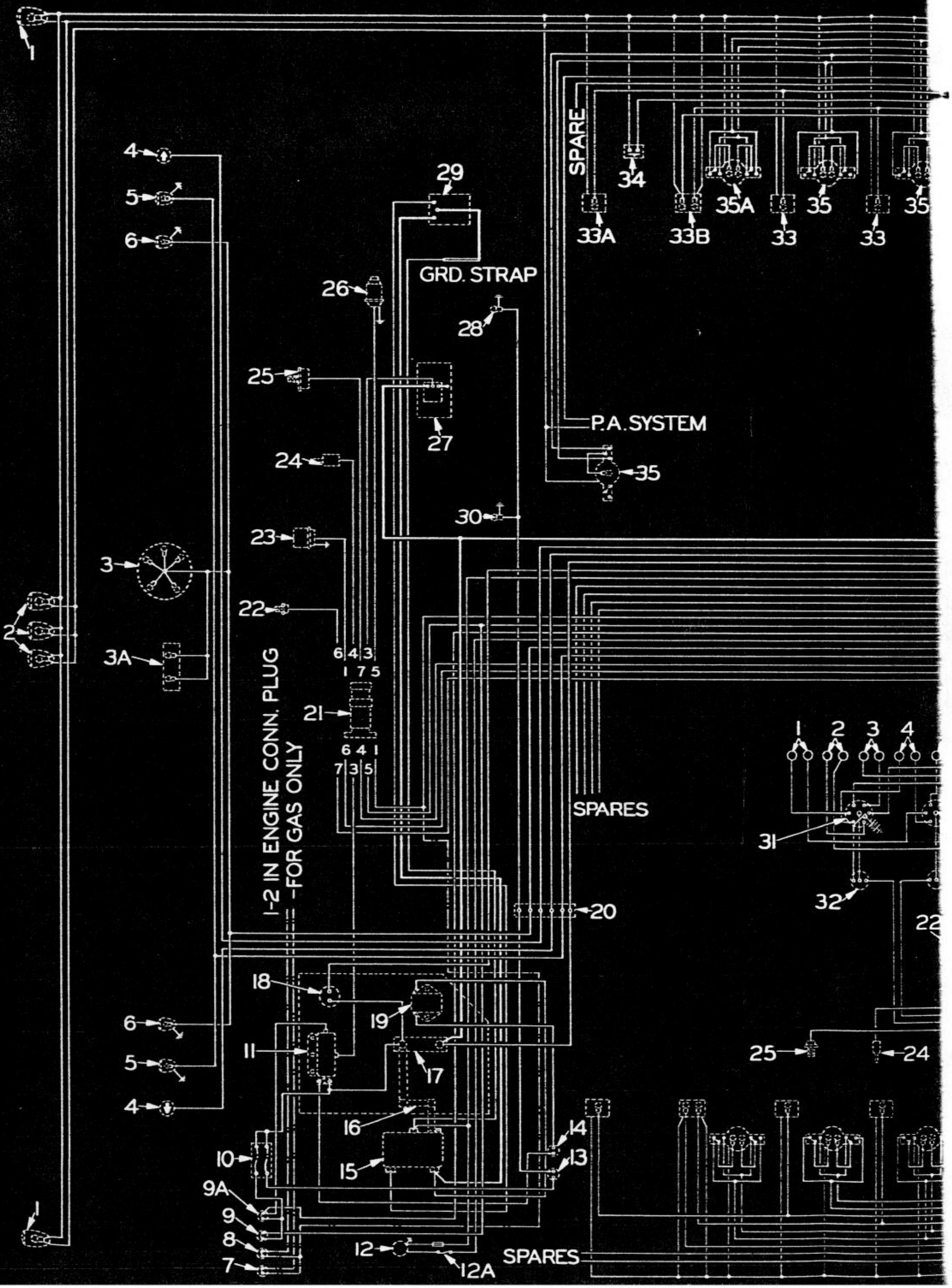
NO	CIRCUIT	WIRE SIZE AND COLOR
6	Reading Lights (2,4,6,8,10, on "Ind" Switch)	#12 - Yellow
7	Passenger Buzzer	#16 - Tan-Black-Red Tracer
8	Rear Michigan Marker Lights	#16 - Black-Red Check
9	R.H. Blower	#14 - Yellow
10	Rear Marker Light	#14 - Black-Green Tracer
11	L.H. Blower	#14 - Red
12	Indirect Lights - 1,3,5,7,9,11,13	#14 - Tan-Black-Red Tracer
13	Emergency Door Switch	#16 - Black-Red Tracer
14	Indirect Lights - 2,4,6,8,10,12	#12 - Black-Green Tracer
15	Defroster Fans	#14 - White
	Spare-P.A. System (Left Side)	#14 - Blue
	Spare-P.A. System (Right Side)	#14 - Blue
	Spare	#14 - Yellow-Blue Tracer

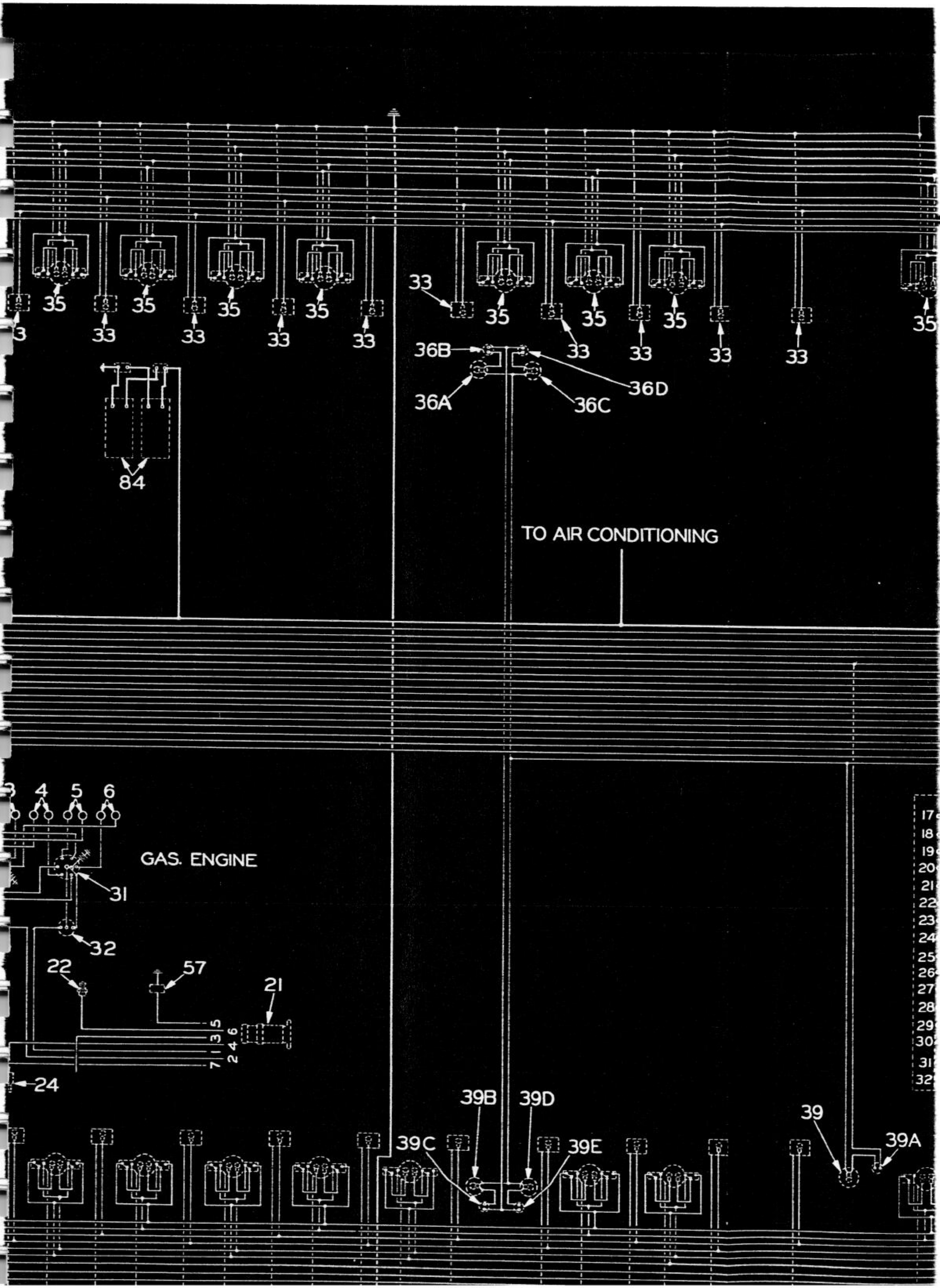
WIRING

WIRING DIAGRAM TABULATION

(See Item Numbers on Wiring Diagram)

ITEM	UNIT	LOCATION	REFER TO GROUP NO.
1	LH and RH Marker Light	Rear Upper R and LH Corner	7L.0001
2	Rear Michigan Marker	Rear Upper Center	7L.0001
3	Highway Sign	Center Rear	3.1701
3A	Rear License Plate Lights	License Box in Rear Engine Door	
4	L and R Directional Signal	L and R Rear	7M.0001
5	Stop Light R and L	L and R Rear	7L.0001
6	Tail Light R and L	L and R Rear	7L.0001
7	Ignition Switch (Gas. Eng.)	Control Box - Rear R.	7S.0001
8	Stop Switch (Diesel)	Control Box - Rear R.	Diesel Manual
9	Starter Switch (Diesel)	Control Box - Rear R.	Diesel Manual
9A	Starter Switch (Gas)	Control Box - Rear R.	7S.0001
10	Fuse Block (2 Fuses)	Control Box - Rear R.	7W.0001
11	Starter Relay	Control Box - Rear R.	7S.0001
12	Speedometer Drive Unit	Engine Compartment R.H. Side	7M.0001
12A	Speedometer Drive Fuse	Speedometer Feeder Line	7M.0001
13	Engine Compartment Light Sw.	Upper R. Corner Engine Compartment	7L.0001
14	Starter Cut-Out Switch	Upper R. Corner Engine Compartment	7S.0001
15	Apparatus Box	Control Box - Rear R.	7G.0001
16	Main Fuse	Control Box - Rear R.	7W.0001
17	Shunt	Control Box - Rear R.	7W.0001
18	Ammeter Gauge	Control Box - Rear R.	7G.0001
19	Starter Cut-Out Relay	Control Box - Rear R.	7S.0001
20	6 Post Junction	Underneath Control Box	7W.0001
21	Engine Compartment Plug	Compartment Side Control Box Panel	7W.0001
22	Temperature Gauge Unit	Rear Engine Water Outlet Manifold	Diesel Manual
22	Temperature Gauge Unit	Rear Engine Water Outlet Manifold	6.7801
23	Emergency Stop Solenoid	On Blower Air Inlet	Diesel Manual
24	Alarmastat (Diesel)	Top of Engine Water Outlet Manifold	Diesel Manual
24	Alarmastat (Gas)	Front End of Cylinder Head	6.7801
25	Oil Gauge Sending Unit(Diesel)	Flywheel Housing	Diesel Manual
25	Oil Gauge Sending Unit(Gas)	Right of Air Comp. Viewed from Rear	8.7101
26	Engine Stop Switch		Diesel Manual
27	Starter (Gas)	Rear of Engine	7S.0001
27	Starter (Diesel)	Rear of Engine	7S.0001
28	Engine Compartment Light(Left)	On Bulkhead Back of Compressor Air Cleaner	7L.0001
29	Generator (Gas)	Left Rear of Engine Compartment	7G.0001
29	Generator (Diesel)	Forward Left Corner of Eng. Compt.	7G.0001
30	Engine Comp. Light (Right)	On Bulkhead Back of Exhaust Manifold Shield	7L.0001
31	Distributor	At Front of Engine Toward Rear of Coach	7D.0001
32	Ignition Coil	With Distributor	7D.0001
33	Indirect Lights	Package Rack Rail-Both Sides	7L.0001
33A	No. 13 Indirect Light PDG and PGG 4101 only	Package Rack Rail - Both Sides at Rear	7L.0001
33B	Night Light	In No. 12 Indirect Light Both Sides	7L.0001
34	Emergency Door Switch	Under Lever of Door	3.1701


SPARE
GRD. STRAP
P.A. SYSTEM
3A
6 4 3
1 7 5
6 4 1
7 3 5
1-2 IN ENGINE CONN. PLUG
-FOR GAS ONLY
SPARES
1 2 3 4
9A
SPARES


TO AIR CONDITIONING
GAS. ENGINE

WIRING

WIRING DIAGRAM TABULATION (CONTINUED)

(See Item Numbers on Wiring Diagram)

ITEM	UNIT	LOCATION	REFER TO GROUP NO.
66	Directional Signal Flasher	On Direction Switch	7M.0001
67	Low Air Switch	In Flare Compartment	4.10401
68	Vibrator Horn	In Air Horn Compartment	7M.0001
69	Horn Button	On Steering Wheel	7M.0001
70	Fog Light Foot Switch	At Driver's Left Foot	7L.0001
71	Head Light Dimmer Switch	At Driver's Left Foot	7L.0001
72	R and L Head Light	At Front (Outer Lights)	7L.0001
73	R and L Directional Signal	At Front	7M.0001
74	R and L Fog Lights	At Front (Inner Lights)	7L.0001
75	Spot Light Switch	On Spot Light Handle	7L.0001
76	Spot Light	At Left of Windshield	7L.0001
77	Stop Light Switch	In Flare Compartment	7L.0001
78	Front Emblem	In Center Front Under Windshield	3.1701
79	R and L Marker Lights	Both Front Upper Corners	7L.0001
80	Front Destination Sign	Above Windshield	3.1701
81	Michigan Marker Lights	Group of Three - Top Front	7L.0001
82	Windshield Defroster Fans	On Windshield Center Bar	3.1701
83	Defroster Fan Switches	Above Driver's Window	3.1701
84	Batteries	Ahead of Left Rear Wheels	7S.0001
85	Diesel Control Switch	On Switch Panel	Diesel Manual

Starting Motor and Battery

Instructions and Illustrations in this Group Apply to Following Subjects:

- Starting Motor Assembly
- Starting Motor Circuit
- Starting Motor Mechanism
- Battery and Mounting
- Lubrication Points
- Specifications
- Test Data

Instructions Applying to Related Parts of Starting Motor Will be Found in Following Groups:

Name	Group No.
Distributor	7D-0001
Generator	7G-0001
Ignition Coil	7D-0001
Spark Plug	7D-0001
Ignition Switch	7D-0001
Wiring Diagram	7W-0001
Control Box Compartment	7W-0001
Instrument Panel	7W-0001

STARTING MOTOR ASSEMBLY

Starting Motor Assembly illustrated in Fig. 1, is mounted to flywheel housing of engine and is a solenoid operated "Dyer" shift type. Starting motor assembly can be readily withdrawn from case by removing three mounting stud nuts. Inspection plate (or plug on Diesel engines) on flywheel housing can be removed for purpose of inspection and adjustment of starter pinion and to oil end bearing.

STARTING MOTOR CONTROL

Starting motor electrical circuit is illustrated on Wiring Diagram in group 7W-0001, tabulations on pages preceeding the diagram key the various connections.

The starting motor solenoid (mounted on starting motor body) is energized by action of one of two switch buttons, one located on instrument panel, and the other in control compartment at right rear of body. Instrument panel and control compartment are illustrated in group 7W-0001.

The solenoid relay and starter control relay are mounted in control compartment. The starter circuit cut-out switch is located at upper right hand corner of engine compartment and is mounted with the engine compartment light switch. Both switches are excessible after right rear engine compartment door has been opened.

Ignition circuit (on Gasoline Engines) is controlled by action of ignition switch on switch panel (at front) and ignition switches in control box compartment. The ignition switch on switch panel ias two positions, "ON" and "OFF". When at "ON" position, ignition circuit is completed through the two distributors. The two ignition switches in control compartment are marked "1" and "2" to control one or both units. It is necessary that both switches in control box compartment be on before switch at panel is operative. Also switch at panel must be in "ON" position to permit operation of control box ignition switches. Engine can be stopped by switches at front or rear.

Diesel ingine control switch operation is described in "Diesel Operating Manual". After starter switch at either front or rear is pressed, circuit is completed through solenoid relay which in turn energizes solenoid. Solenoid operation is such that initial movement of magnetic core engages starter pinion with flywheel before circuit is closed and armature revolves.

Control circuit is completed to ground through contact points of starter control relay. When engine starts to run at speed sufficient to produce generator voltage, points open in relay to break control circuit. In this manner, accidental engagement of starter pinion is prevented while engine is running. After engine starts, starter pinion is disengaged from flywheel teeth by means of spiral armature shaft.

The starter circuit cut-out switch is for the purpose of breaking starter circuit to prevent accidental starting of engine while mechanic is servicing power plant. As a matter of safety, this switch should always be turned off BEFORE engine is serviced.

STARTER DRIVE MECHANISM

The pinion meshes with flywheel by means of solenoid operated sleeve as previously

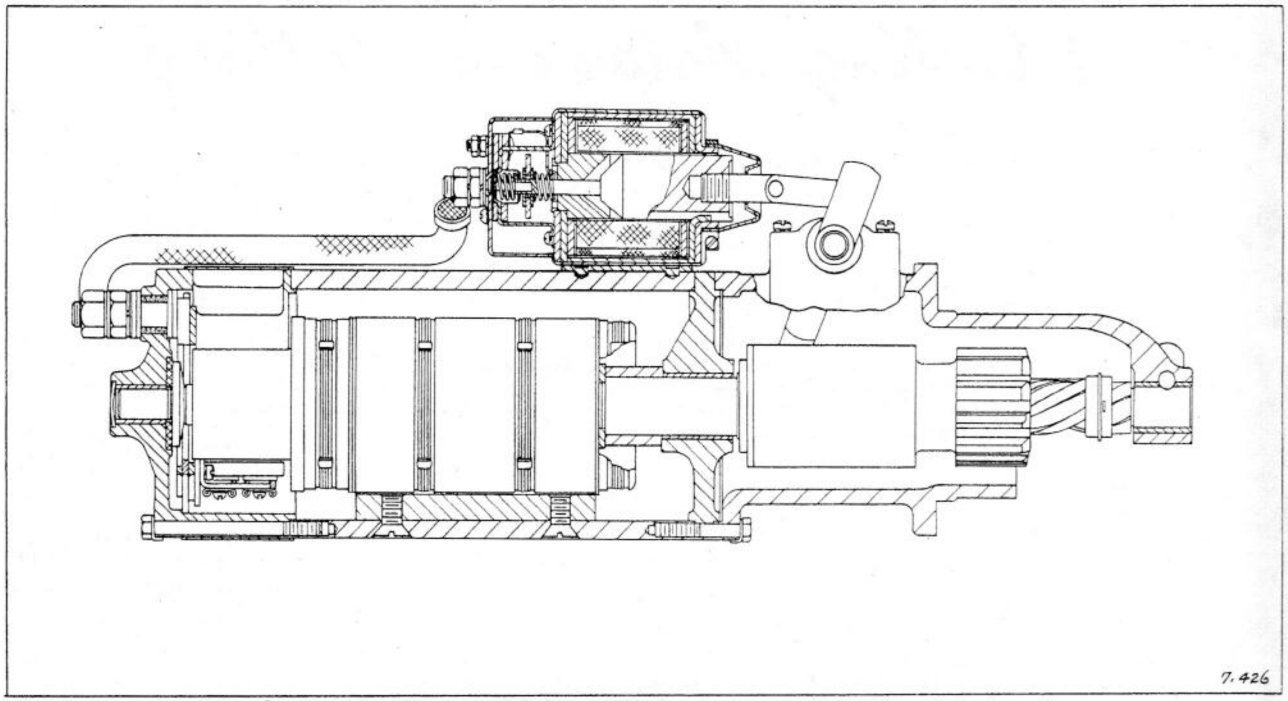


Fig. 1 Starting Motor and Solenoid Mechanism as Used on Diesel Engine Shown - Gasoline Engine is of Similar Construction, Except an Oil Seal is Provided at Center Bearing

described. The shift lever of motor is connected by linkage to solenoid. Return spring is used to hold shift lever in proper position when not in use.

The detailed action of drive can be followed by referring to Figs. 2, 3, 4, 5, and 6, and accompanying explanation. Each illustration represents a position or step through which drive assembly passes in a complete cranking operation. The drive housing, shift sleeve, and pinion are cut away showing action of parts. The engine flywheel is shown so that relative action of drive with flywheel can be noted.

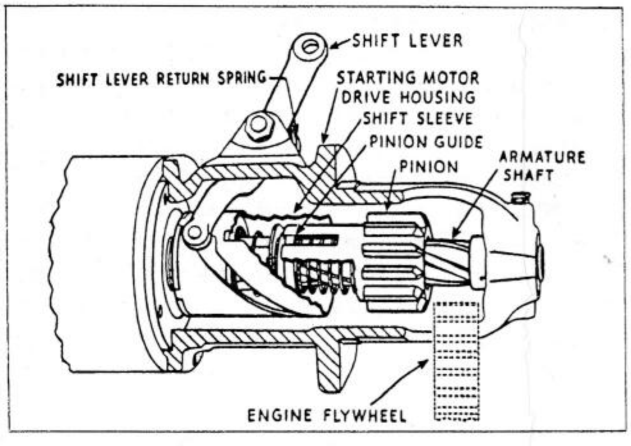


Fig. 2 "At Rest" Position - Pinion is Locked in This Position When Out of Mesh With Flywheel

FIG. 2 - AT REST POSITION

For the "At Rest" position pinion is held away from flywheel by locking action of pinion guide and pinion spring in milled portion of the shaft spline. Refer to Fig. 6. The engine may or may not be in operation when drive is in this position. It is impossible for pinion to drift into flywheel when it is in this locked position.

FIG. 3 - BEGINNING OF ENGAGEMENT

The engine is "dead" and cranking operation has begun. As shift lever moves shift sleeve towards flywheel, pinion guide is unlocked from milled portion of spline by pressure of inner sleeve on guide. This action allows pinion to reach flywheel. If relative position of flywheel and pinion is such that teeth match, meshing will take place immediately. If teeth butt on engagement pinion is further rotated in its movement toward flywheel until it reaches position for meshing. Compression of inner coil spring against pinion guide compensates for continued movement of shaft lever and shift sleeve.

FIG. 4 - ENGAGEMENT ACTION COMPLETE

When pinion has been rotated to proper position for engagement, action is completed by further movement of shift lever and action of pinion spring. The pinion stop limits travel of pinion. When meshing of pinion with flywheel is completed, further movement of shift lever closes starting motor switch contacts.

FIG. 5 - OPERATING POSITION

As starting motor begins to crank engine, shift sleeve is carried back to its original position by rotation of armature shaft and sleeve moves back and rotates as indicated by arrow. It is rotated by action of stud in shift lever and spiral slot in shift sleeve. When engine fires, accelerating action disengages pinion from flywheel and pinion returns to locked or "at rest" position.

It is impossible to start another cranking operation until complete cranking cycle is finished. After engine fires, shift lever should be allowed to return to "at rest" position and unit is then ready for another cranking operation.

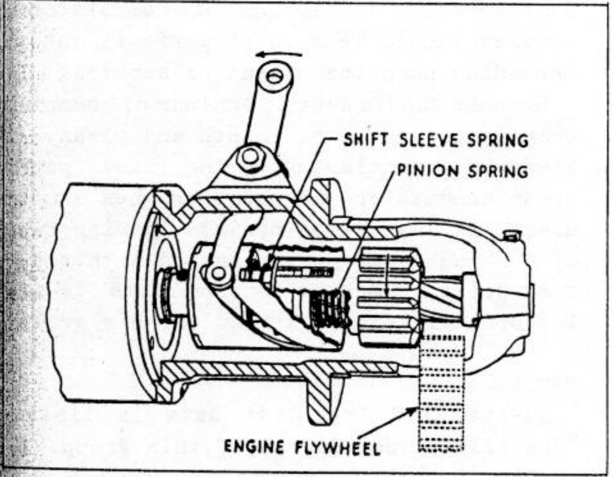


Fig. 3 Beginning of Engagement Action - Pinion Rotates as it is Moved Toward Flywheel

It is impossible to engage pinion while engine is running for as soon as pinion teeth touch moving flywheel teeth, shift sleeve is rotated and pinion follows armature shaft spline back to locked position (See Fig. 6).

FIG. 6 - RELATIVE POSITION OF PARTS

This illustration does not represent a step in actual cranking operation, but merely shows position of the lock in shaft spline.

The engagement movement of shift lever is always against tension of shift lever return spring. (See Fig. 2). When a cranking operation is completed and shift lever is returned, continued tension of shift lever return spring creates a force on armature assembly towards commutator end of starting motor. This force is transmitted through armature brake directly against brake washer in commutator end of motor (Fig. 1). The force of brake against brake washer stops armature almost immediately after shift lever is allowed to teturn. This feature makes starting motor ready, immediately, for another cranking operation in case engine does not continue to operate after it fires.

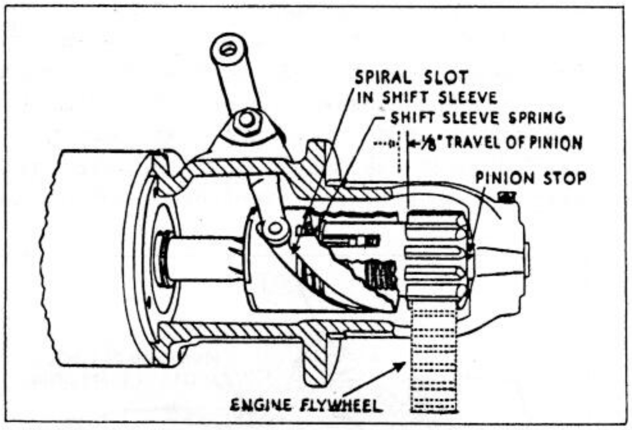


Fig. 4 Engagement Action Complete. Pinion is Fully Engaged for Cranking

ADJUSTING DRIVE

The drive is properly adjusted before leaving the factory.

When shift lever is in extreme forward position and switch contacts in solenoid are closed, there should be at least 1/8" - 3/16" travel of pinion against pinion spring pressure as indicated. (See Fig. 4). This adjustment can easily be checked by disconnecting

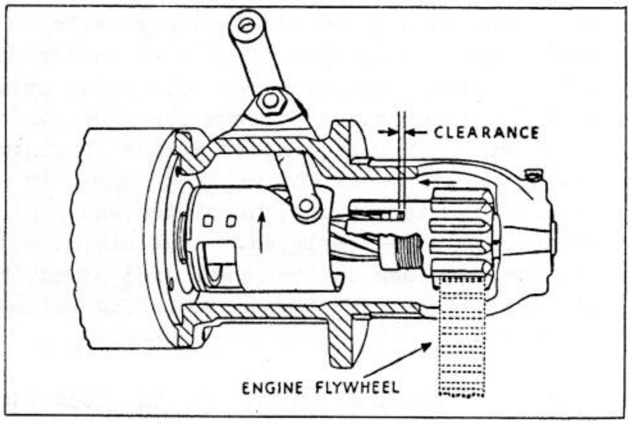


Fig. 5 Operating Position-Pinion Remains in Mesh until Engine Starts

lead from solenoid to starting motor and using battery current through solenoid to hold shift lever in forward position. Since disconnecting this lead opens pull-in coil of the solenoid, it may be necessary to assist movement of plunger by hand to assure that plunger will reach its extreme travel position, closing the switch contarts. The starting motor armature will not revolve with this lead disconnected.

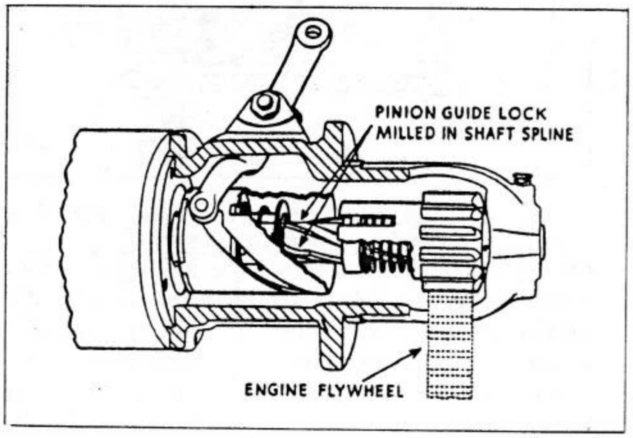


Fig. 6 Showing Relative Position of Drive Parts

The pinion travel can be checked by pushing pinion back against spring pressure. The adjustment can be changed by turning plunger stud in or out of solenoid plunger as necessary.

A test can be made to determine if engagement action is being completed before switch contacts are closed. This can be done by placing a 3/4" spacer between pinion and pinion stop. The shift lever can then be moved forward forcing pinion against the spacer. It should not be possible to close switch contacts with spacer inserted. This adjustment can be changed as mentioned above.

When the pinion is in driving position (Fig. 5) there should be 1/32" clearance between pinion guide and bottom of slot as indicated. If there is no clearance at this point drive will be taken directly from lugs on pinion guide rather than from heavy spline in pinion itself. If it is found that there is no clearance at this point, the pinion and pinion guide should be replaced. The pinion with its lock and lock spring is released by moving pinion shift sleeve forward and along splines of shaft.

In reassembling parts, pinion lock lugs should be in slots in the pinion hub with lugs toward pinion or it will not be in the proper position to lock on the shaft.

STARTING MOTOR MAINTENANCE

Starting motor should be removed every 20,000 miles of service, and shifting mechanism carefully cleaned and lubricated with light engine oil. This procedure will prevent accumulation of gummy substance on splined starter shaft which would affect engagement of pinion with flywheel ring gear. At these inspection periods, adjustment of pinion and linkage should also be checked as previously discussed.

BRUSHES AND COMMUTATOR

Inspection of brushes and commutator can be made after cover band at rear end of motor is removed. Inspection of commutator and brushes should be made at periodic intervals depending upon the extent of service.

Brushes should seat to contour of commutator. Commutator should be smooth and clean. The standard practice of using sand paper to clean commutator and seat brushes should be used. At inspection periods, spring tension of all brush arms may be tested with accurate test scale. Spring tension data is listed in "Specifications" at end of this group.

TESTS

No-load and lock test data is listed in "Specifications" at end of this group.

RELAYS

The starter relay and starter control relay require little attention except periodic inspection and adjustment of contact points. Contact point and air gap dimensions are listed in "Specifications".

The starter relay is located at upper left corner of control compartment while the starter control relay is located directly to the right of starter relay (see illustration of control compartment in group 7W-0001).

BATTERIES

Two batteries are mounted in body compartment just ahead of left hand rear wheel. See Fig. 7 . Each battery is mounted and clamped to individual trays which roll on tracks in both upper and lower compartments. Batteries may be rolled out of compartments separately for inspection and servicing, or each battery may be removed from compartment independently for replacement.

To remove lower battery and tray, disconnect two cables at center. Pull tray out, at same time lift front of tray off of truck rollers. Tray and battery can then be pulled out of compartment on rear tray roller. When removing upper battery, disconnect four connections at center terminal bar before pulling tray out of compartment. To remove battery from tray, remove both front and rear hold down clips.

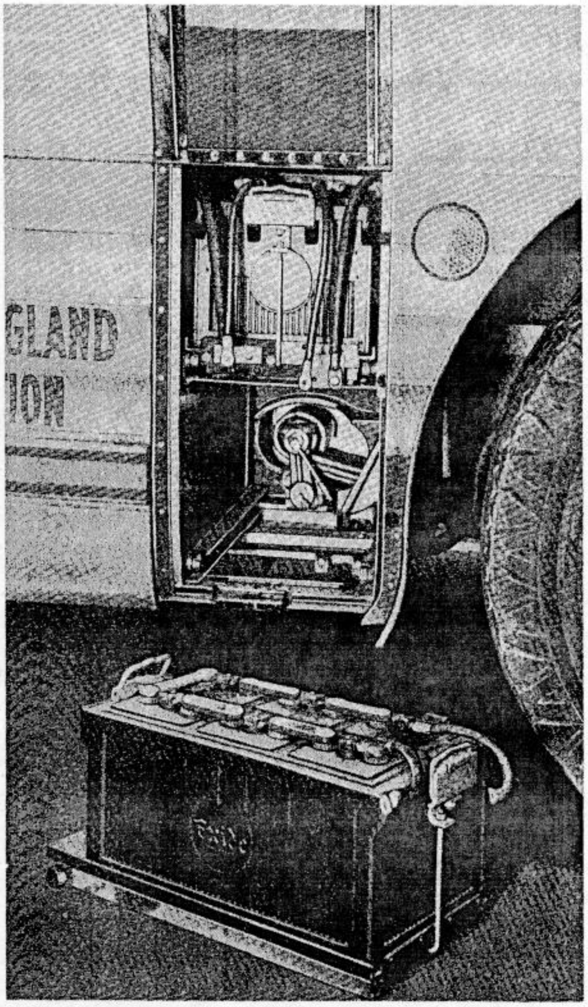


Fig. 7 Battery Compartment is Located Just Ahead of Left Rear Wheel

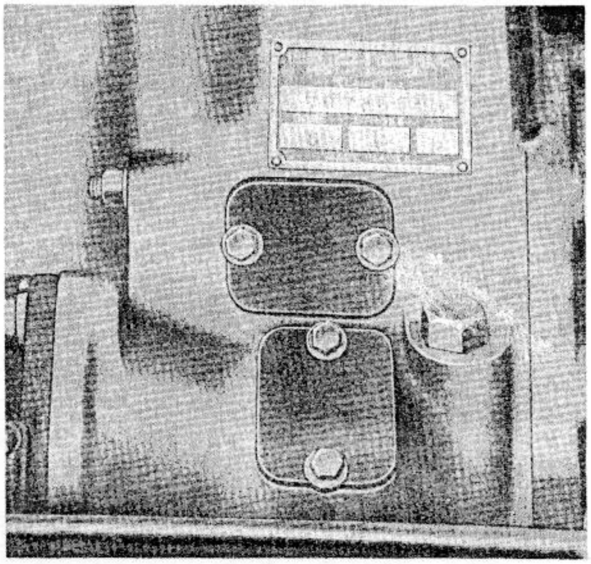


Fig. 8 Inspection Plate Must be Removed to Oil Drive End Bearing (Gasoline Engine Shown - Plug Must Be Removed on Diesel Engines)

Positive posts of battery are grounded. Ground wire extends to terminal on body frame in back of top battery. Battery compartment door can be locked with standard socket key.

Batteries should be checked each week. Test each cell with an accurate reading hydrometer. Add distilled water to bring level approximately 3/8" above plates. Terminals should be cleaned at regular intervals with solution of ammonia and water. Coat each terminal with petroleum jelly after clamping into place. Connections must be kept light and clean.

LUBRICATION POINTS

Starting motor armature shaft is supported by three bushing type bearings. Front and rear bearings can be lubricated through individual snap-cover oil cups. Lubricate at intervals shown in "Lubrication" group with light engine oil. It is necessary to remove flywheel housing inspection plate, (or plug on Diesel engines) Fig. 8, to oil bearing at drive end.

SPECIFICATIONS

(STARTING MOTOR USED ON GASOLINE ENGINES)

STARTING MOTOR

Model-------------------------------000791

Make---------------------------Delco-Remy

Type--------Solenoid Operated--Dyer Shift

Rotation--at drive end--Counter-Clockwise

Brush Tension - Oz.-----------------36-40

NO LOAD TEST

Amperes--------------------------------65

Volts--------------------------------12.0

RPM----------------------------------4500

LOCK TEST

Amperes-------------------------------725

Volts---------------------------------4.8

Torque lbs. ft.------------------------44

STARTER RELAY

Model--------------------------------264G

Make -------------------------Delco-Remy

Air Gap with Points Closed----------.012"

Point Opening-----------------------.035"

STARTER CONTROL RELAY

Model-----------------------------1116757

Make--------------------------Delco-Remy

Point Opening-----------------------.030"

SOLENOID (on Starter)

Model-----------------------------1118026

BATTERY

Voltage--------------------------------12

Terminal Grounded----------------Positive

SPECIFICATIONS

(STARTING MOTOR USED ON DIESEL ENGINES)

STARTING MOTOR

Model-----------------------------1108703

Make--------------------------Delco-Remy

Rotation-----------------------Clockwise

Brush Tension---------------36-40 Oz.

NO LOAD TEST

Amperes-------------------------------100

Volts--------------------------------11.6

R.P.M.-------------------------------5000

LOCK TEST

Amperes-------------------------------570

Volts---------------------------------2.3

Torque Lbs. Ft.------------------------20

STARTER RELAY (On Control Box)

Model--------------------------------264G

Make--------------------------Delco-Remy

Air Gap With Points Closed----------.012"

Point Opening-----------------------.035"

Starter Control Relay

Model-----------------------------1116757

Make--------------------------Delco-Remy

Point Opening-----------------.010"-.030"

SOLENOID ON STARTING MOTOR

Model-----------------------------1118026

Make--------------------------Delco-Remy

Battery

Voltage--------------------------------12

Terminal Grounded----------------Positive

Specific Gravity

Fully Charged-----------------1.275-1.300

Recharge @-------------------------1.225

ALWAYS SHUT OFF STARTER CUT-OUT SWITCH BEFORE WORKING ON ENGINE.

Distributor, Coil and Spark Plugs

Instructions and Illustrations in This Group Apply to Following Subjects:

- Distributor
- Distributor Mounting
- Ignition Circuit
- Distributor Adjustment
- Condenser
- Ignition Coil
- Spark Plugs

Instructions Applying to Related Parts of Distributor Will be Found in Following Groups:

Name	Group No.
Wiring Diagram	7W.0001
Starting Motor	7S.0001
Battery	7S.0001
Switches	7W.0001

Two distributors of type shown in Fig. 1 are mounted side by side on drive housing and are driven through spiral gears mounted on distributor and water pump drive shaft; see Figs. 2 and 3. Drive shaft gear at end of drive shaft meshes with and is driven by idler gear which in turn meshes with crankshaft gear. See Fig. 2. Spiral driven gear and fuel pump lubricating rod eccentric are integral and are held in place on distributor shift with a pin.

Each distributor is full automatic advance type and is equipped with two pairs of contact points. In addition to full automatic advance, manual advance is provided on each distributor housing to set ignition for best engine performance possible with different grades of fuel.

IGNITION CIRCUIT

Ignition circuit is controlled by action of ignition switch on switch panel (at front) and ignition switches in control box compartment. The ignition switch on switch panel has two positions; "ON" and "OFF". When at "On" position, ignition circuit is completed through the two distributors. The two ignition switches in control are marked "1" and "2" and control either or both distributors.

The purpose of the dual switches on control compartment is to test each distributor, or in case of a short in one distributor during a run, the opposite distributor may be used temporarily.

BREAKER POINT ADJUSTMENT

Each distributor is fitted with two sets of breaker points; one is termed as "movable" (1 - Fig. 1) and the other as "stationary" (2 - Fig. 1). The movable contact points are mounted on a plate which can be moved by means of eccentric screw to various positions with relation to cam.

The six-lobe cam on distributor shaft separates both pairs of contact points simultaneously when points are properly adjusted and synchronized.

It is important that both distributor caps be removed when checking timing or performing and other service which requires ignition being "ON". Otherwise engine may start and serious injury to mechanic is almost certain to result.

Also make certain that starter relay switch in engine compartment is open to prevent engine being started accidentally from front and while service work is being performed.

Before attempting to retime or synchronize ignition, points must be cleaned and adjusted in following manner:

1. See that contact points are clean and smooth, and that they seat squarely on each other.
2. Turn engine until breaker arm on each pair of contacts rests on high point on cam.
3. Loosen both clamp screws (3). Turn eccentric screws (4) until gaps between contacts in both pairs are .018" to .024". Check gap opening with a round feeler gauge after tightening clamp screws.
4. At the time contact points are cleaned and adjusted, it is advisable to thoroughly clean inside of distributor cap and points which may be dirty.

CHECKING IGNITION TIMING AND SYNCHRONIZING CONTACTS

Information given in paragraphs immediately following covers checking of timing and

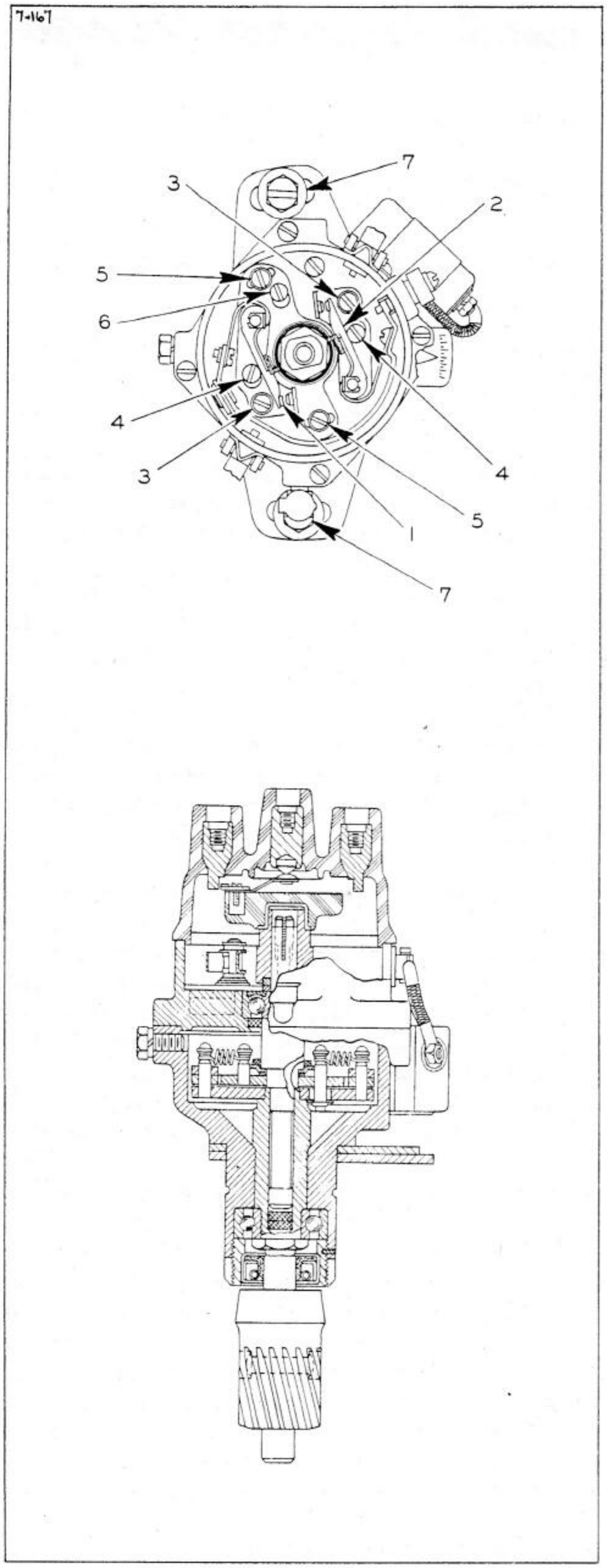


Fig. 1 Distributor Showing Adjustment Points

synchronization of both pairs of contacts in each distributor. Added efficiency resulting from use of two sets of spark plugs will be lost; however, if distributors are not properly synchronized with each other to insure both plugs in same cylinder firing at same instant.

Instructions given under "Synchronizing Distributors" should be followed carefully as the final step in any service, major or minor, which is performed on distributor contacts.

As two distributors are used, it is necessary to insulate all contact points except those which are being checked.

Check timing and synchronize in following manner:

1. Set manual advance arm at "Zero" on indicator scale.
2. Loosen clamp screw (5) on adjusting plate and turn eccentric screw (5) until movable contacts separate after stationary contacts as engine is turned.
3. Insert a piece of thin cardboard between points on adjustable plate. Connect ignition test lamp between primary terminal on distributor, and ground at any convenient point on engine.
4. Turn engine slowly with ignition switch "on" until No. 1 piston is coming up on compression stroke. Continue to turn engine very slowly, stopping at instant test lamp flashes on, indicating that contacts have opened. Check "IGN" mark on balancer (See Fig. 3). If the mark "IGN" is within 1/8" of indicator point, timing on this set of points may be considered correct.
5. If timing of stationary contact points is not correct, loosen lock screw in center of breaker cam, and turn cam just enough to secure correct timing. If cam is so tight that it cannot be turned readily, it can be loosened with offset screwdriver or similar tool, used to pry it upward. Always pry against breaker plate; never against side of housing. Make sure that distributor rotor is still in line with No. 1 contact. Check setting again by turning engine and observing when test lamp flashes on.
6. With mark on balancer remaining in same position, remove insulation from movable contacts and insert it between stationary contacts. Loosen adjustable plate clamp screws (5) and turn eccentric screw (6)

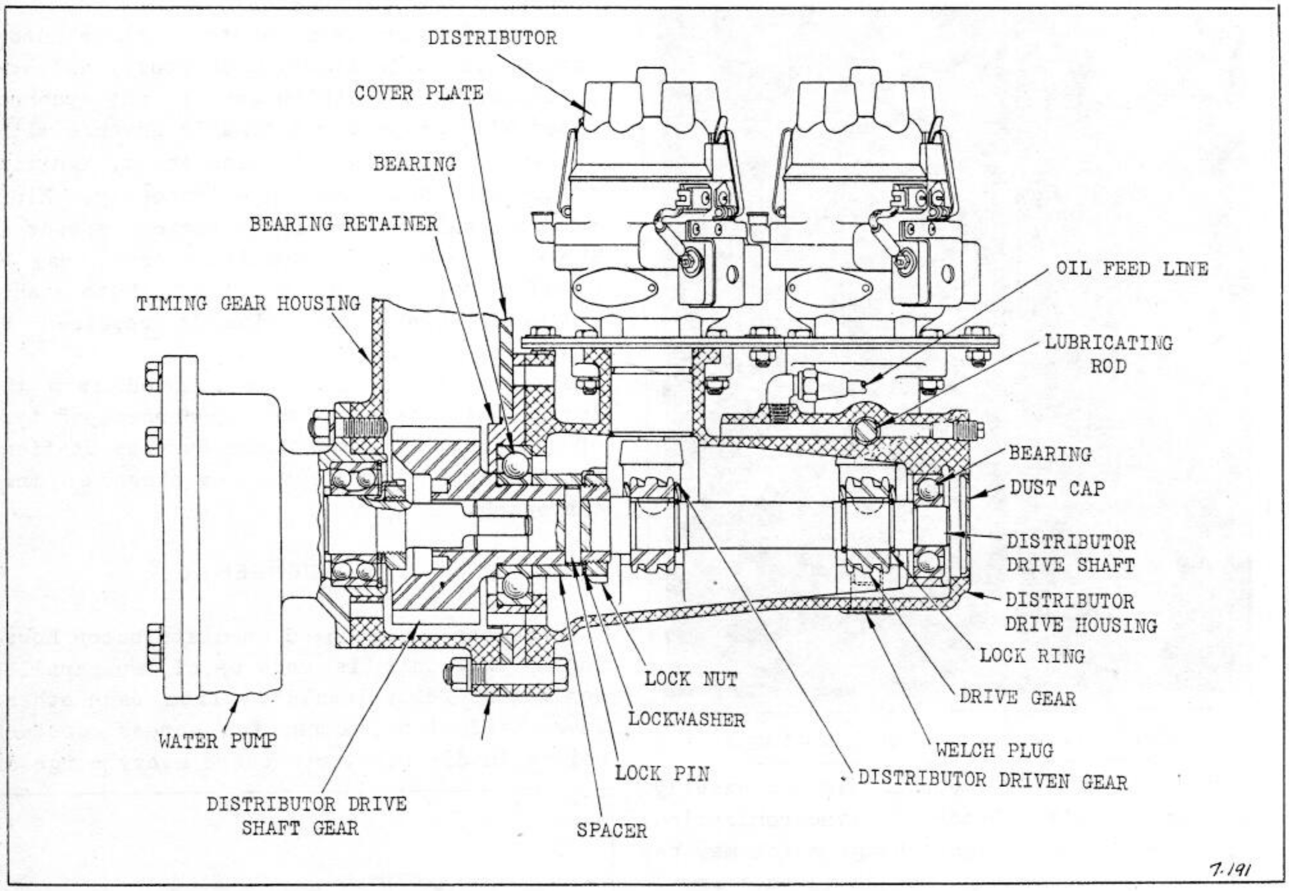


Fig. 2 Distributors are Tandem Mounted as Shown

until test lamp flashes on again, indicating that movable contact points have opened.

7. Test setting again by checking position of balancer ignition mark when each set of contact points opens. Bear in mind that when checking one set of contact points, the other set must be insulated. The position of timing marks for both pairs of contacts should be as close together as possible, never more than 1/8" apart.

Follow the foregoing procedure on both distributors.

RETIMING IGNITION

1. When retiming distributor, set engine so that No. 1 piston is in firing position, i.e., turn engine untill No. 1 piston begins to rise on compression stroke and continue to turn slowly until ignition timing mark "IGN" on balancer registers exactly with indicator.
2. Locate No. 1 spark plug wire segment in distributor cap; place cap in proper position on distributor; mark housing opposite No. 1 segment so that its relative position will be known after cap is removed.
3. Loosen breaker cam lock screw in top distributor shaft and turn cam until contact points just start to open when rotor is pointing toward mark on housing.
4. Set both distributors in same manner.
5. Tighten cam lock screw and check timing and synchronization with test lamp as previously described.

SYNCHRONIZING DISTRIBUTORS

To synchronize distributors, insulate both sets of points on one distributor as well as movable contacts on other.

Connect test lamp across uninsulated points and turn engine slowly noting exact relation of "IGN" mark on balancer with pointer when light flashes.

Next, fully insulate first distributor tested and movable contacts only on second unit, connecting test lamp across uninsulated contacts as before.

Turn engine slowly noting again, relation of "IGN" mark with pointer when light flashes.

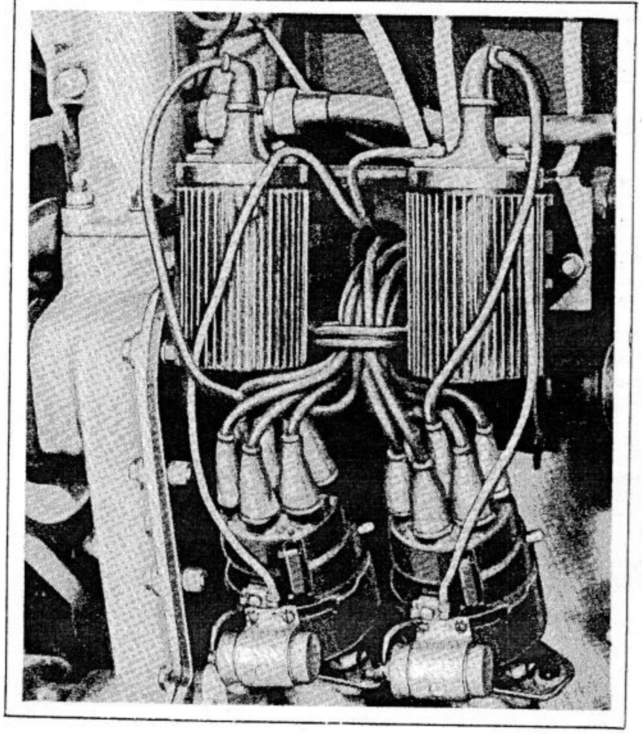


Fig. 3 Distrubutor and Coil Mounting

Position of "IGN" mark should be exactly same for both distributors if synchronization is correct. Any slight change which may be required can be made at manual advance arms.

If both sets of contacts in each distributor are properly synchronized with each other, plugs in each cylinder should fire simultaneously.

TESTING IGNITION SETTING

After ignition has been timed according to foregoing instructions, coach should be tested on road, using, if possible, same grade of fuel as will be used in service.

With spark plug gaps adjusted properly, move advance indicator at base of each distributor exactly same amount so that engine "pings" slightly when thoroughly warmed up under full throttle at comparatively low vehicle speed. This setting may vary with different fuels.

To advance or retard from initial setting, loosen screw (7 - Fig. 1) on each side of support plate, rotating distributor as required. After distributors have been synchronized with each other, it is very important that exactly same changes be made on both distributors if proper timing is to be maintained.

AUTOMATIC ADVANCE MECHANISM

Automatic advance mechanism on distributors used with dual ignition, is carefully adjusted at factory. If distributors are not synchronized with respect to automatic advance within limits shown in following chart, ignition system will not function efficiently. Minimum and maximum advance at various speeds as shown in chart (in Specifications) may be used for purpose of checking distributors when automatic advance mechanism is repaired or replaced.

The distributor must be removed from the engine and tested with "synchroscope" type of equipment. United Motor Service Stations are equipped with testing machines of this character.

CONDENSER

Condenser is mounted on distributor housing. This unit is made up of two parallel conductors fully insulated from each other. These conductors, connected across contact points in distributor, absorb heavy surge of

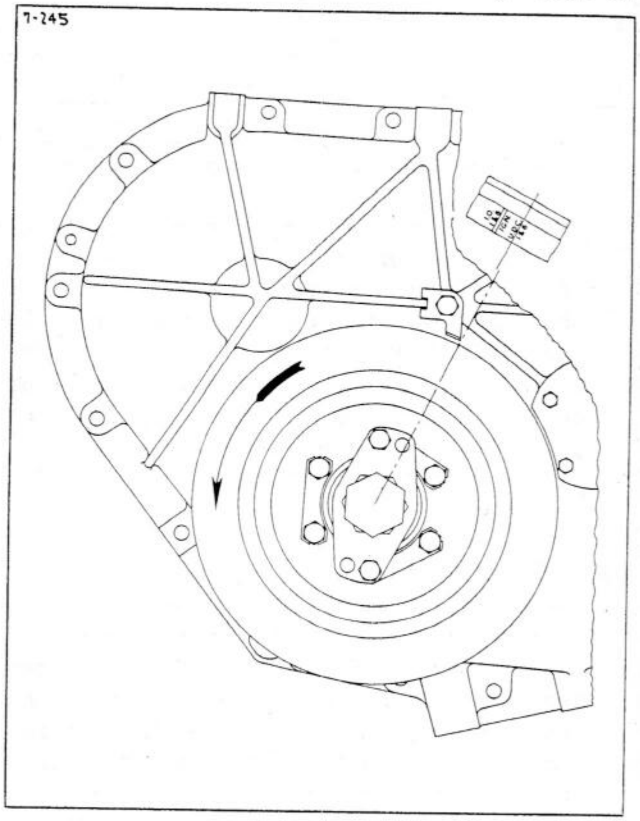


Fig. 4 Ignition Timing Marks on Crankshaft Torsion Damper

current as contacts separate, and thereby eliminate arcing and burning at points.

Any break in either of these conductors or short circuit between conductors in condenser reduces capacity of unit to absorb current surge. Therefore, rapid burning and fouling of breaker contacts is definite indication of faulty condenser. Since accurate tests of condenser can only be made with special testing apparatus not generally available, most convenient way of determining whether condenser is at fault is to install new unit or one known to be in good condition, noting engine performance and condition of points after operation.

SPARK PLUGS

Two spark plugs are used in each cylinder. This feature, with proper synchronization of contact points and distributor, results in quicker and more complete burning of gas in combustion chamber.

An appreciable interval of time in the compression and power strokes is required for the flame to pass through the entire mass of gases in the combustion chamber when ignited from one point only. It will be seen that this time interval will be reduced if ignition occurs simultaneously from two points at some distance from each other.

Time interval for complete combustion and maximum expansion of burning gases requires earlier ignition timing with one plug than with two firing simultaneously. Therefore, maximum efficiency of engine depends largely upon proper timing and synchronization of distributor contact points.

CARE OF PLUGS

Spark plugs best suited for average conditions are listed in "Specifications" section. Type numbers as listed should always be used.

Plugs should be inspected at regular intervals, and cleaned and adjusted if necessary. Gap opening on all plugs should be the same and should conform to measurements shown in "Specifications" section. Always use a round feeler gauge to set gap opening.

LUBRICATION POINTS

Following is a description of operations necessary to lubricate distributor (used with Gasoline Engine only). Refer to Lubrication Chart (Group 13) for lubricant specifications and periods.

1. Distributor shaft bearings - two oil cups - one on each distributor - accessible through left hand engine compartment door - use oil can.
2. Distributor cams - use Petrolatum sparingly.

DISTRIBUTOR

SPECIFICATIONS

DISTRIBUTOR
Model---------------------------------4211
Make---------------------------Delco-Remy
Rotation---------------Counter-Clockwise
Start Advance
Engine R.P.M.-------------------------400
Degree Engine---------------------------2
Intermediate Advance
Engine R.P.M.-------------------------800
Degree Engine--------------------------14
Maximum Advance
Engine R.P.M.------------------------2000
Degree Engine--------------------------36
Firing Order------------------1-5-3-6-2-4

IGNITION COIL
Model-----------------------------1115251
Make---------------------------Delco-Remy

SPARK PLUGS
Model----------------------------------85
Make-----------------------------------AC
Gap-------------------------------.030"

AUTOMATIC ADVANCE CHART

Engine Speed R.P.M.	Automatic Advance Engine Minimum	Degrees Average	Advance Maximum
400	0	0	0
500	1	2	3
600	4	5.5	7
700	7	8.75	10.5
800	9	11.5	14.0
1000	11	13.5	16.0
1200	13.5	15.5	17.5
1400	15.0	17.0	19.0
1600	17.0	19.0	21.0
1800	18.5	20.5	22.5
2000	20.5	22.5	24.5
2200	22.0	24.0	26.5
2400	22.0	24.0	26.0

Generator and Control

Instructions and Illustrations in This Group Apply to Following Subjects:

Generator	Ammeters
Generator Mounting	Lubrication Points
Apparatus Box	Specifications

Instructions Applying to Related Parts of Generator Will be Found in Following Groups:

Name	Group No.	Name	Group No.
Starting Motor	7S.0001	Wiring Diagram	7W.0001
Battery	7S.0001	Lighting Equipment	7L.0001
Distributor	7D.0001		

GENERATOR ASSEMBLY

Generator assembly is mounted on left side f engine compartment behind engine (toward ront of coach), between forward radiator nd auxiliary fuel tank. Generator is strapped o a mounting cradle (See Fig. 1), which is hinge" mounted to upper structure of engine ompartment. The hinge type mounting permits djustment of position of generator for the urpose of obtaining correct belt tension. The cradle is held rigid by means of adjustable trut rod extending between mounting cradle nd engine.

The cradle hinge pin (at top) swivels on ronze bushings mounted in cradle. The cradle upport brackets, which hold the hinge pin at oth ends and the adjusting strut rod ends re equipped with rubber insulating bushings.

Fan blade assembly mounted at front end of enerator provides cooling for the forward adiator and assists in ventilation of enerator. The rear end of generator is onnected to an air duct casting by means of ubber boot which is snapped on end of generator and clamped with metal band to duct asting. The air duct casting is connected o air conditioning return air duct by means f rubber hose. See Fig. 2.

Air, flowing from air-conditioning return uct into generator, is further accelerated y action of fan. Fan and generator are riven with two belts by crank shaft pulley.

REMOVING GENERATOR

Generator is accessible for minor servicing and inspection from under coach. The following operations apply to removing and replacing unit.

1. Open radiator doors and drain radiator (see "Cooling" group).
2. Disconnect batteries. (see Starting Motor" group).
3. Loosen generator belt adjusting screws as much as possible so the fan blades move freely.
4. Disconnect top and bottom hose on forward radiator.
5. Remove lower support plate and flap from both radiators.
6. Place lifting jack under forward radiator.
7. Pull top radiator pins on forward radiator.
8. Slightly bend forward radiator shroud to permit clearance with rear radiator.
9. Lower jack and at same time force radiator down so top water pipe will clear body.
10. Pull radiator out at bottom.
11. Remove fan blades from generator.
12. Disconnect wires at generator.
13. Loosen rubber boot clamp at air duct.
14. Remove outside belt. Take off at generator pulley, then at crankshaft pulley. Remove inside belt in same manner.
15. Remove lower water hose from rear radiator.
16. Place high-lift wheel jack under generator.
17. Remove generator straps.
18. While balancing generator on jack, lower jack about three inches. Withdraw assembly from coach.

Reverse preceding instructions to reinstall.

ADJUSTING GENERATOR BELTS

Generator fan belts should be adjusted for proper tension as shown in Fig. 3. Generator belts are furnished only in matched pairs and should be installed as such.

BEARINGS

Armature shaft at rear end of generator

(toward air duct) is supported on ball type bearing. Fan and pulley hub is mounted on opposed tapered bearings. When these bearings are installed, tighten retaining nut until there is no perceptible end play and pulley revolves freely.

GENERATOR MAINTENANCE

INSPECTION

The following inspections should be made on generator at periodic intervals.

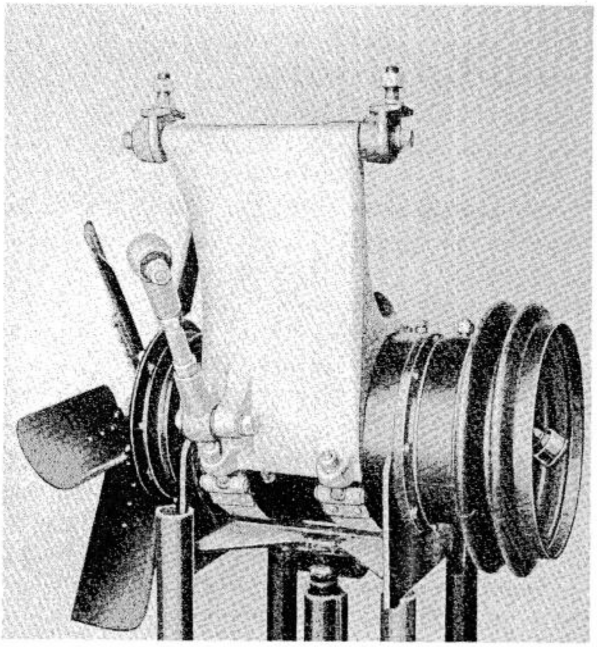


Fig. 1 Generator ready to be Mounted.

1. Check terminals.
2. Clean commutator with "00" sandpaper and examine brushes.
3. If commutator is rough or worn down to mica, remove armature and take a light cut off of commutator. Mica should be undercut 1/32". All brushes should have at least 75% seat on commutator.

OPERATION TESTS

The ammeters on instrument panel and in control compartment are merely indicators to show whether or not generator is functioning. To determine exact output of generator accurate test ammeter should be used.

If the generator and regulator are not operating satisfactorily, the following checks should be made to determine which unit is at fault before making any adjustments to the regulator.

FULLY CHARGED BATTERY WITH LOW CHARGING RATE

Above condition indicates that generator and voltage regulator units are functioning properly. To verify this, note charging rate at a medium generator speed, then use cranking motor with engine switch off, to partly discharge battery (about 10 seconds) and with generator running at a medium speed, note charging rate. Since battery voltage has been lowered, generator output should show an increase for a short time.

To check current regulator unit, bridge voltage regulator unit contact points with a jumper lead to prevent voltage regulator unit operating. Turn on lights or other electrical loads and increase generator speed until output remains constant. The output reading is value for which current regulator unit is set.

If the output fails to increase to specified value, current regulator unit setting is probably low. If it is impossible to adjust current regulator unit to increase output to specified value, check as outlined under "LOW BATTERY WITH LOW OR NO OUTPUT". If output continues to increase to beyond specified value, depress current regulator unit armature manually, separating points. If generator output now drops off, current regulator unit is either out of adjustment or current regulator winding assembly is defective. If output continues high, it indicates there is a short between contact points which prevents resistance being inserted in generator field circuit as points separate. This short may be in current regulator winding assembly or at fibre insulation which insulates top contact point.

FULLY CHARGED BATTERY WITH HIGH CHARGING RATE

Above condition indicates that voltage regulator unit is not reducing generator output as it should. A high charging rate to a fully charged battery will cause battery to gas and overheat. It also produces excessive voltage in electrical circuit which will cause armature, (ignition coil and distributor point) on gasoline engine and lamp bulb failure.

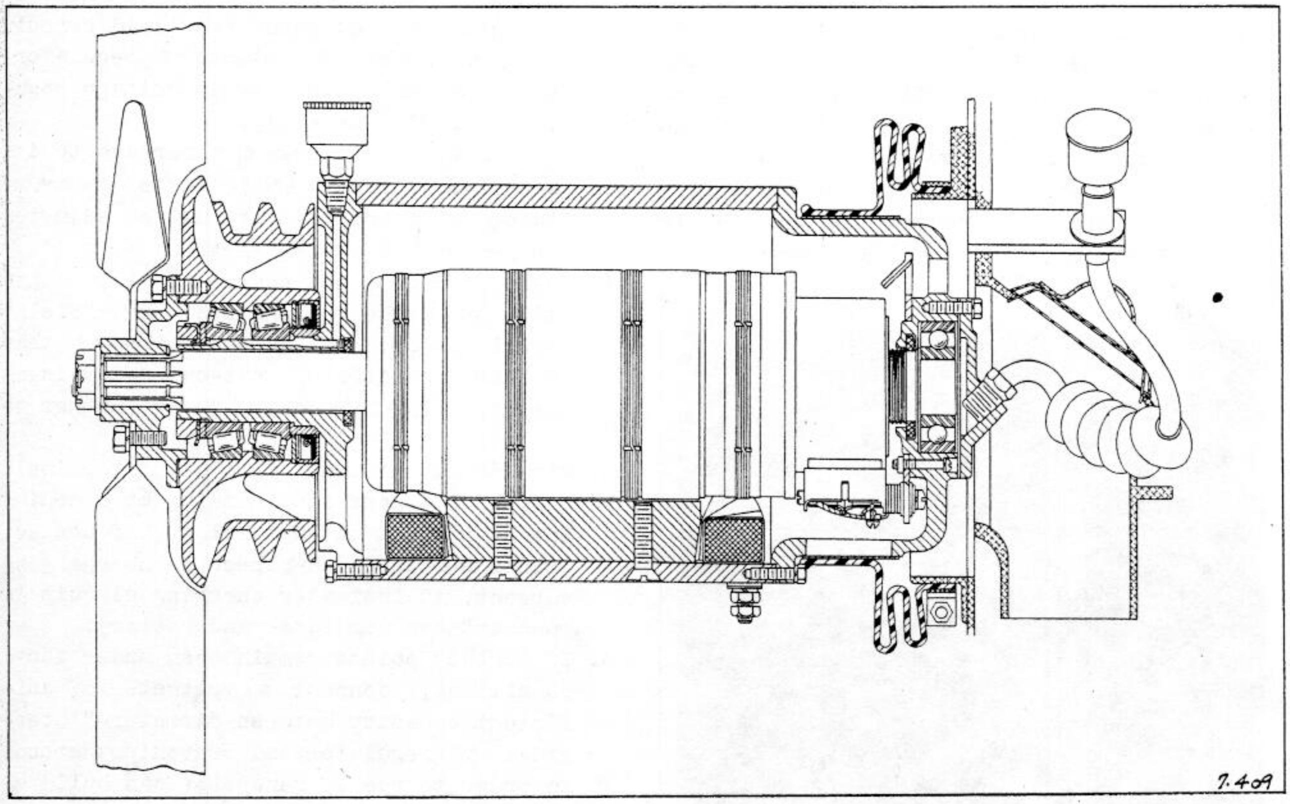


Fig. 2 Sectional View of Generator and Air Duct Connections.

This condition will result if - (a) voltage regulator unit is out of adjustment; (b) there is a defective winding in voltage regulator unit which prevents unit operating; (c) there is a direct short between generator charging circuit and generator field circuit, either in regulator or generator, which prevents resistance being inserted in generator field circuit when contact points open, or (d) there is a poor ground connection between generator and regulator. Inspect the ground wire or mounting for this condition.

Hold voltage regulator unit armature down manually. If the output now drops off as contact points are opened, voltage regulator unit needs either adjustment or a new winding assembly.

If output continues high as points are separated, it indicates a short between charging circuit and generator field circuit. Remove "Field" lead from "Field" terminal of regulator to determine location of short. If output drops off, the short is in regulator and it should be inspected for burned leads, windings or charred insulation. If output continues high with "Field" terminal wire removed, short is in wiring or generator. Remove wire from "F" terminal of generator. If output now drops off, short is in the wiring; if it continues high, generator is at fault.

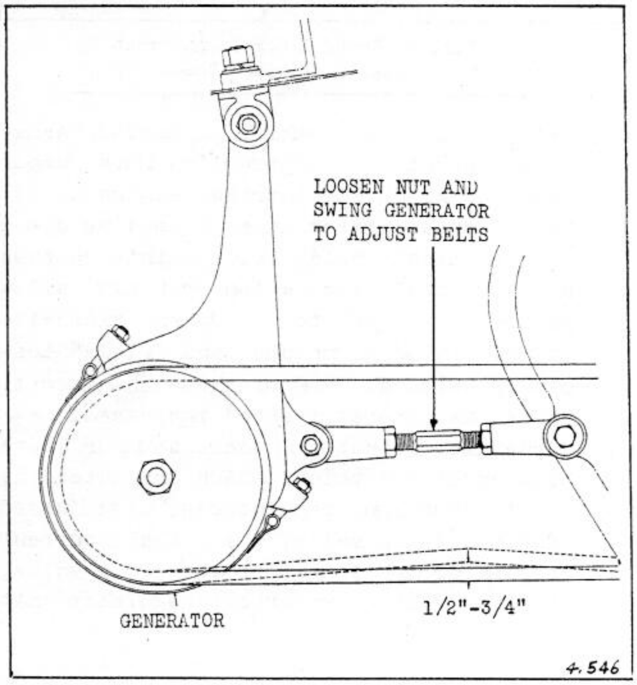


Fig. 3 Adjust Generator Belts as Shown.

LOW BATTERY WITH LOW OR NO CHARGING RATE:

Check circuit for loose connections, frayed or damaged wires. High resistances in charging circuit, due to these conditions, would cause voltage regulator unit to operate as though battery were fully charged, reducing generator output, even though battery was still in a partly discharged condition. If the trouble is not in wiring, proceed as follows:

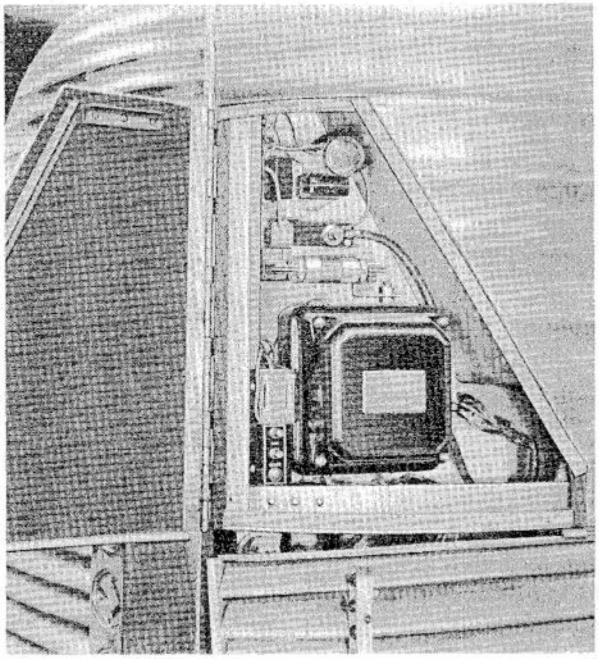


Fig. 4 Control Box Compartment
(Gasoline Switch Shown)

1. Bridge regulator terminals marked "Armature" and "Field" temporarily with a jumper lead and gradually increase engine speed. Do not run generator at an excessive speed with terminals bridged, since this removes all external regulation and may allow generator output to reach an excessive value. With "Armature" and "Field" terminals bridged, one of three things will happen as generator speed increases.

(a) Generator output will increase to or above its specified value, which indicates, (a) that the voltage regulator unit is adjusted for too low a value, (b) that current regulator unit is set for too low a value, (c) the voltage or current regulator unit contact points are oxidized and must be cleaned, or (d) generator field circuit is open at some point within the regulator, either at connections or in voltage regulator winding assembly.

(b) Generator output does not increase to its specified value, which indicates generator is at fault and that it must be adjusted or removed for bench test.

(c) Generator does not charge at all, either with or without "Armature" and "Field" terminals bridged, which indicates that either generator or cut-out relay is at fault. In this case, check further as below.

2. With "Armature and "Field" terminals bridged and generator running at a medium speed, inspect cut-out relay. If contact points are closed, and there is no charging current, it indicates charging circuit is open between regulator and battery.

3. If contact points remain open under above conditions, connect a voltmeter of sufficient capacity between "Armature" terminal of regulator and convenient ground in order to see if generator can build up voltage. If voltage builds up satisfactorily without causing cut-out relay contact points to close, cut-out relay is either out of adjustment, or, shunt winding on the cut-out relay is open. CAUTION: NEVER UNDER ANY CONDITION CLOSE RELAY CONTACT POINTS MANUALLY WHILE BATTERY IS CONNECTED. LOW RESUSTANCE THROUGH GENERATOR AND REGULATOR WOULD ALLOW SUFFICIENT CURRENT TO FLOW TO DAMAGE THE EQUIPMENT.

4. EXCESSIVE ARCING OR SLUGGISH ACTION OF CONTACT POINTS IN EITHER VOLTAGE OR CURRENT REGULATOR UNIT INDICATES:

(a) Resistance unit is open.

(b) A defective winding in regulator winding assembly.

(c) Contact points are pitted or oxidized and must be cleaned or replaced.

(d) Contact points are not meeting with correct alignment or pressure, in which case they must be adjusted.

(e) Shorted field coil in generator.

(f) Poor ground connection between generator and regulator. Inspect ground wire or mounting for this condition.

REGULATOR UNIT

The regulator unit or apparatus box is a five unit type mounted in control box compartment at right rear of coach, Fig. 5. Wiring diagram in group 7W.0001 illustrates all circuits pertaining to generator and regulator.

The regulator consists of voltage regulator unit; field relay which operates in conjunction with voltage regulator; current regulator unit; cut-out solenoid; actuating relay which operates cut-out solenoid.

The CURRENT REGULATOR operates to hold generator out put to safe maximum.

The VOLTAGE REGULATOR unit and FIELD RELAY combine to control voltage so as to cause generator to deliver proper charge to battery as required by battery and load.

The CUT-OUT SOLENOID and ACTUATING RELAY operate together to close circuit between generator and battery when generator voltage is sufficient to force a charge to battery and to open circuit when generator voltage falls below this value.

The ACTUATING RELAY is a precision relay, set accurately within narrow limits and is connected across generator to close relay points when generator voltage is sufficient to charge battery. This energizes cut-out solenoid, which closes multiple contact points to complete circuit between generator and battery. This multiple contact arrangement is provided to insure ample contact area to carry maximum ampere output of generator.

When generator voltage falls below a value sufficient to charge battery, actuating relay points open and points of cut-out solenoid in turn open to break circuit between generator and battery.

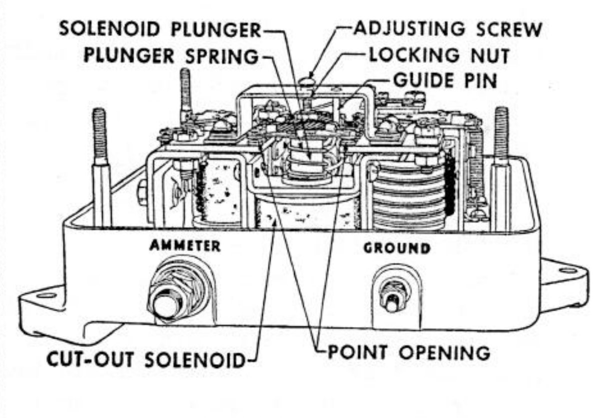
REGULATOR ADJUSTMENTS

MECHANICAL CHECKS

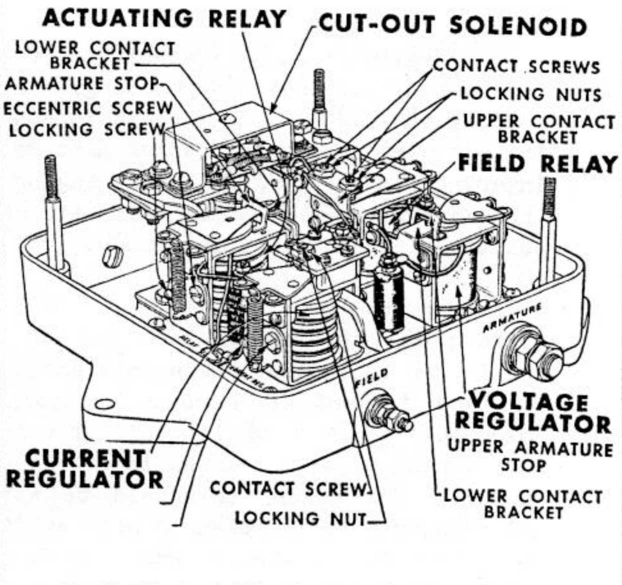
Regulator unit must be disconnected before following checks are made. See Fig. 5.

FIELD RELAY

With contact points closed, air gap between core and brass pin in armature should be .010". To adjust, loosen two locking nuts and turn contact screws in or out as required. The point opening of each set of points must be identical so that each set carries half the total current. A final check should always be made after regulator has been reinstalled and is in operation. If more arcing takes place at one set of points than at other, it indicates that set



Cut-Out Solenoid Adjustments.



Checks and Adjustments of Actuating Relay, Field Relay, Current and Voltage Regulator Units

Fig. 5 Control Box Showing Adjustment Points.

is carrying more than its share of current and points must be re-adjusted so arcing is identical for each set of points. If adjusting contact screws does not give sufficient range, further adjustment of air gap may be made by loosening two screws which hold upper contact bracket and raising or lowering bracket as required. See Fig. 5.

VOLTAGE REGULATOR

Push armature down until points just meet. With points just touching, adjust air gap between brass residual pin and armature to .018"-.020" by moving lower contact bracket. Release armature and adjust upper armature stop to give a point opening of .005"-.008". See Fig. 5.

CURRENT REGULATOR

Push armature down against brass pin in core and adjust contact screw to give a point opening of .012"-.015". Always loosen locking nut when making this adjustment to avoid injuring contact spring. When gauging opening do not move upper contact from its natural position against fibre insulator.

CUT-OUT SOLENOID

The point opening at each set of points should be .050" and all points should meet at same instant as plunger is drawn into solenoid. Adjust by loosening locking nut and turning adjusting screw in or out as required. The guide pin should be straight and plunger free in solenoid with sufficient spring tension (2.5-3.0 pounds with points closed) to cause points to separate with a snappy action when released.

ACTUATING RELAY

Push armature down until points just meet. In this position air gap between core and brass pin in armature should be .050"-.060". Adjust by loosening two lower contact bracket mounting screws and raising or lowering lower contact bracket as required. Release armature and adjust armature stop to give .020" point opening. See Fig. 5

ELECTRICAL ADJUSTMENTS

If regulator is detached, it must be placed in an oven and heated until all units are 135° - 145° F. which is operating temperature The regulator must then be connected to type generator and battery with which it normally operates and electrical checks quickly made, before regulator has a chance to cool. If regulator is on coach it may be checked without being removed, provided it has been in operation for a sufficiently long time (30 minutes to an hour) for all parts of the regulator to reach actual operating temperature. THE REGULATOR MUST BE AT OPERATING TEMPERATURE AND IN ACTUAL OPERATING POSITION (Vertical or Horizontal) WHEN ELECTRICAL SETTINGS ARE CHECKED AND ADJUSTED. The five units of the regulator must be checked in the following order:

FIELD RELAY

Disconnect lead from AMMETER terminal of regulator so regulator is open circuited. Short circuit contact points of voltage regulator with a jumper lead to prevent it operating. Connect a voltmeter between ARMATURE terminal of regulator and ground. Drive generator at approximately 2000 R.P.M. Voltage should be 8.0 volts with zero output. Adjust by loosening locking screw and turning eccentric screw to increase or decrease voltage setting as required. After tightening locking screw, check setting by stopping generator and bringing it back to speed again. Remove jumper lead after test.

VOLTAGE REGULATOR

With regulator still open circuited, and voltmeter still connected between ARMATURE terminal and ground as in previous test, operate generator at 2000 r.p.m. and note open circuit operating voltage. Voltage should be 15.0 volts. Adjust by loosening locking screw and turning eccentric screw to increase or decrease voltage setting. After tightening locking screw, check setting by stopping generator and then bringing it back to speed again. NEVER ADJUST VOLTAGE REGULATOR SETTING BELOW ACTUATING RELAY VOLTAGE SETTING. TO DO SO WILL PREVENT CUT-OUT SOLENOID FROM OPERATING AND WILL PREVENT BATTERIES FROM BEING CHARGED.

CUT-OUT SOLENOID

With lead from the AMMETER terminal still disconnected, and voltmeter connected between ARMATURE terminal and ground as in previous tests, short circuit contact points of actuating relay with a jumper lead. Slowly increase generator speed and note voltage necessary to operate solenoid plunger. The solenoid plunger should close with a snappy action at less that 9.0 volts with solenoid at operating temperature. Reduce generator speed and note voltage at which solenoid points open. They should open at not less than 4 volts. Remove jumper lead from actuating relay points after test.

ACTUATING RELAY

With voltmeter still connected between ARMATURE terminal and ground as before, connect a test ammeter capable of reading above 120 amperes between AMMETER terminal and lead originally connected to this terminal. Slowly increase generator speed and note voltage necessary to operate relay. The relay points should close at 13.5 volts with relay at operating temperature. Adjust by loosening locking screw and turning eccentric screw to raise or lower operating voltage. After tightening locking screw, check setting by bringing generator to stop, then slowly increasing speed to note voltage at which relay operates. As generator speed decreases, note reverse current and voltage at which points open. The points should open with not more than 7.0 amperes reverse current at 12.8 volts.

CURRENT REGULATOR

With ammeter connected into charging circuit at AMMETER terminal as in previous test, connect a jumper lead temporarily between contact points of field relay. Increase generator speed until current regulator begins to operate and ammeter reading remains constant. It is recommended that on coach, all lights, fans, heaters and other electrical units be turned on during this check to avoid excessive voltage. On test bench a .1 ohm (one-tenth ohm) resistance capable of carrying 120 amperes may be connected across battery while current regulator is being checked. Adjust current regulator setting by loosening locking screw and turning eccentric screw to increase or decrease current setting. After tightening locking screw, check current setting by stopping generator and then bringing it back to speed again.

CAUTION

Do not attempt to make mechanical adjustments or close actuating relay or solenoid points by hand while regulator unit is connected to battery. This would permit sufficient current to flow from battery through regulator to cause serious damage to equipment.

LUBRICATION POINTS

Generator bearing at fan end is lubricated by grease cup, accessible from under coach. Rear bearing (air duct end) is lubricated by removing hand hole cover, on some coaches, on air duct casting to reach grease cup which is mounted at rear end of generator housing. On other coaches, grease cup is mounted above hand hole cover on bracket attached to air duct casting as shown in illustration. Fig. 5.

SPECIFICATIONS

GENERATOR

Model--------------------------------1117518
Make----------------------------Delco-Remy
Rotation-----------------Counter-Clockwise
Brush Tension------------------------25 Oz.
Field Current @ 12 Volts---1.78-1.92 Amps.

COLD OUT-PUT

Amperes----------------------------------120
Volts-----------------------------------13.0
Approx.R.P.M.--------------------------850

REGULATOR UNIT

Model-------------------------------005620
Make----------------------------Delco-Remy
Type--------------------------------5 Units

VOLTAGE REGULATOR

Air Gap------------------------.018"-.020"
Point Opening------------------.005"-.008"
Voltage Setting(open circuit @ 135° F.)-
---------15.0

CURRENT REGULATOR

Point Opening------------------.012"-.015"
Current Setting - Amps.----------------120

CUT-OUT SOLENOID

Point Opening------------------------.050"

ACTUATING RELAY

Point Opening------------------------.020"
Air Gap------------------------.050"-.060"
Points Close - Volts------------------13.5

Lighting Equipment

Instructions and Illustrations in This Group Apply to Following Subjects:

Switches	Exterior Lights
Interior Lights	Bulb Data

Instructions Applying to Related Parts Will be Found in Following Groups:

Name	Group
Wiring Diagram	7W-0001
Fuse Data	7W-0001
Door Lights	3.1701
Destination Signs	3.1701
Emblem	3.1701
Highway Sign	3.1701
License Holders	3.1701

LIGHT SWITCHES

MAIN SWITCH PANEL

Main switch and fuse panel is illustrated on Fig. 1. This panel is mounted on dash. Tabulations under illustration indicates use of each switch.

Other light switches are described in succeeding paragraphs. Light bulb specifications are listed at end of this group. Fuse specifications are listed in group 7W.0001.

INTERIOR LIGHTING EQUIPMENT

READING LIGHTS

Reading lights are located over each group of two seats on right and left sides of coach and over center of rear cross seat. The light fixtures are mounted on underside of package rail.

Each reading light has two bulbs independently controlled by separate switches when panel switches are properly positioned by driver. There are four controlling switches on switch panel, two of which are marked "ALL", and two marked "INDIV".

For normal operations on road, two switches marked "INDIV" should be turned "ON". This gives each passenger control of his light. When coach pulls into terminal, or at anytime driver wants all lights lit he may turn on two switches marked "ALL". That is, for all lights to be lit regardless of position of switch at each light both "ALL" switches and both "INDIV" switches must be turned "ON".

Bulbs in reading lights are accessible when lens and retainer are removed.

INDIRECT LIGHTS

Indirect lights are located on upper edge of package rack and are controlled by two switches on switch panel, marked "INDIV". Alternate lights are turned on or off by each switch. Bulb in each light is accessible by removing lens and retainer.

NIGHT LIGHTS

Night light bulbs, controlled by panel switch marked "Sign", are mounted in last indirect lights at rear on right and left sides (next to last on 41 passenger coaches). These bulbs are blue in color.

DASH LIGHTS

Two dash lights are mounted in switch and fuse panel, and three on instrument panel. These lights are controlled by switch marked "Rear" in "Marker" group. The two lights in switch and fuse panel are automatically shut-off when the sliding panels are closed.

EXTERIOR LIGHTING EQUIPMENT

BAGGAGE COMPARTMENT LIGHTS

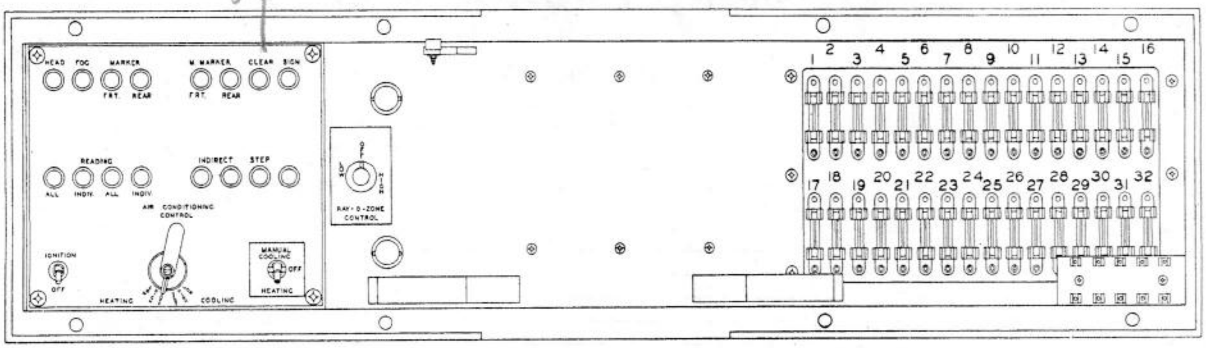
Baggage compartment light and switch is located at the upper outer corner of each compartment. Each light is controlled by individual switch mounted near light. Compartment lights are automatically shut-off when compartment doors are closed.

ENGINE COMPARTMENT LIGHTS

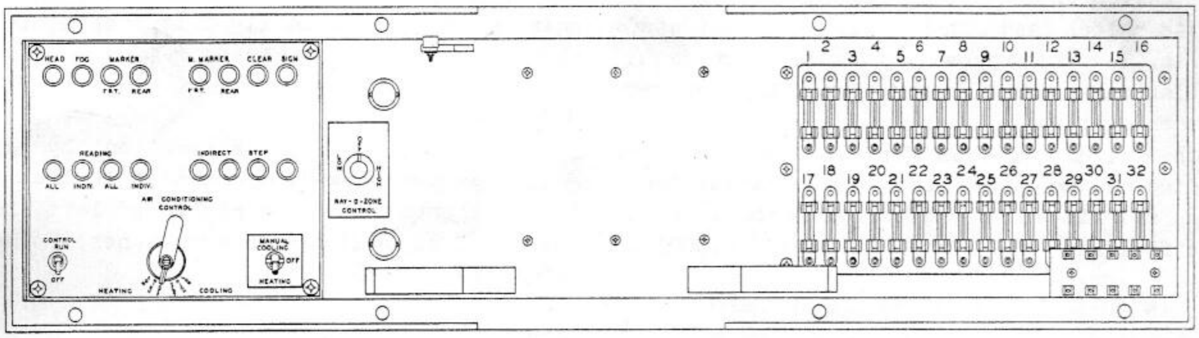
Two engine compartment lights are located on rear upper bulkhead of engine compartment. The left light is located immediately under and back of air compressor air cleaner, while the right light is located back of carbureter intake pipe toward muffler shield. These lights are controlled by a switch mounted on upper right hand rear corner of compartment,

Sign & markers

LIGHTING EQUIPMENT



Switch and Fuse Panel When Gasoline Engine Is Used



Switch and Fuse Panel When Diesel Engine Is Used

Fig. 1 Light Switch Tabulation

Top Row - Left to Right

"HEAD"	Controls Headlamps
"FOG"	Controls Foglamps
"MARKER"	(Group of Two)
"FRT"	Front Markers Only
"REAR"	Tail Light, Highway Sign, License Plate Holders
"M.MARKER"	(Group of Two)
"FRT"	Front Michigan Markers
"REAR"	Rear Michigan Markers
"CLEAR"	When Clearance Lights are Used
"SIGN"	Front and Side Signs, Emblem and Night Lights

Bottom Row - Left to Right

*"READING"	(Group of four)
"ALL"	Alternate Lights
"INDIV"	Alternate Lights
"ALL"	Alternate Lights
"INDIV"	Alternate Lights
*"INDIRECT"	(Group of Two)
1st	Alternate Lights
2nd	Alternate Lights
"STEP"	Front Step Light
Blank	Spare

* Refer to explanations under "Reading Lights" and "Indirect Lights".

with starter control cut-out switch. Right rear engine compartment door must be opened to gain access to these switches.

MARKER LIGHTS

Front and rear marker lights are located on upper right and left hand front and rear corners. These lights are controlled by group of two switches marked "Marker" on front switch panel.

Michigan markers are groups of three lights mounted at front and rear of coach on upper panels. These lights are controlled by two switches marked "M. Marker" on front switch panel.

STOP LIGHT

Two stop lights are mounted at rear on right and left hand sides on panels which include tail lights and rear directional signals. The stop lamps are the top lights of each group and are controlled by air operated switch. Fig. 2. The switch is interconnected with brake application valve as shown on Air Lines Diagram in group 4.10401. The switch is mounted in the front upper corner of flare compartment (at left front of coach).

Tell-tale light (marked "Stop") mounted on instrument panel signals when stop lights are operating. Stop light relay is mounted on buzzer and relay panel located behind switch and fuse panel. If tell-tale light fails to illuminate when brakes are applied, inspection of stop light bulbs and circuit should be made.

The relay requires no attention except periodic inspection. At regular intervals, check contact points of stop light switch for corrosion or pitting. This condition may be remedied by filing points lightly with a distributor file. As can be noted in illustration, contact point portion of the assembly can be readily disassembled for inspection of points and diaphragm.

TAIL LIGHT

Two tail lights on right and left hand, are mounted with rear directional signals and stop light. The tail lamps are the lower lights of group. Tail lights are controlled by switch in "Marker" group marked "Rear".

HEAD LIGHTS

Head lamps illustrated in Figs. 3 and 4, are "Sealed Beam" type. The lens, reflector and bulb are serviced as a complete unit. If lens is damaged, bulb burned out, or reflector damaged, replacement of complete unit must be made. The bulb is double filament type, providing a high and a depressed beam.

Head lamp circuit is controlled by push and pull switch marked "HEAD" on switch panel. The foot dimmer switch, located accessible to drivers left foot, controls high and depressed beams.

PROPER USE OF HEAD LAMPS

Since it is not economically feasible to provide fixed highway lighting on more than a small percentage of rural highway mileage, the driver must depend on headlights for night time visibility. The modern headlamps are carefully designed and accurately manufactured. The headlamps can provide safe seeing for moderate speed if:

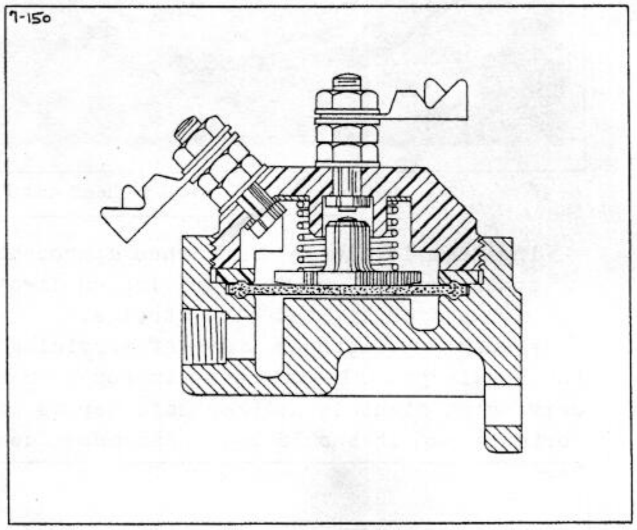


Fig. 2 Stop-Light Switch Is Located In Flare Compartment

1. They are aimed correctly.
2. They are equipped with standard parts - that is, if the lens, reflector and bulb unit is either the original equipment or replacement by the original manufacturer.
3. The headlamp lens is clean, bulb is not blackened, and all electrical equipment and connections are kept in proper condition so as to insure adequate voltage to lamps.
4. They are used properly - that is, if the upper beam is used when there are no approaching drivers, and the lower or meet-

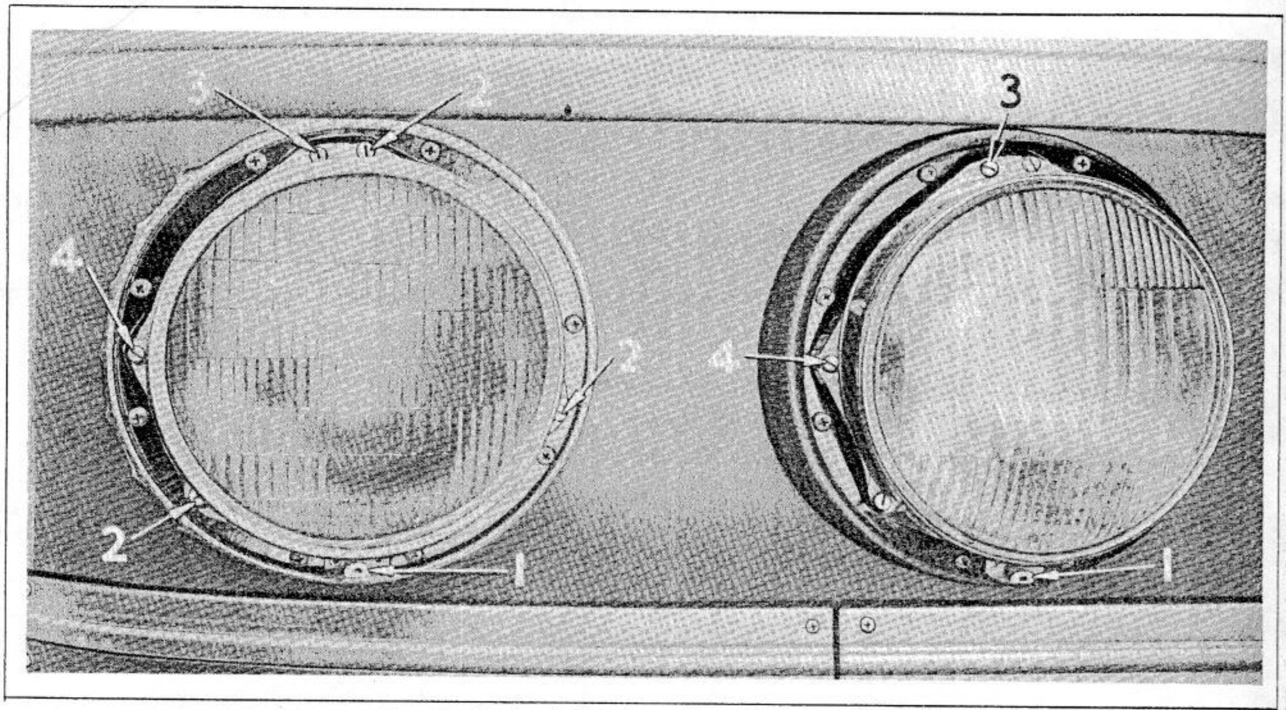


Fig. 3 Head and Fog Lamps Are Mounted As Shown

ing beam is always used when approaching other drivers, and when driving on lighted highways or lighted city streets.

Because of improper care of servicing of the headlamps, misaim, and improper usage driving at night is neither safe nor as comfortable as it should be. Annoyance due to glare is frequent, and many accidents, especially those involving pedestrians, are caused by the driver's inability to see sufficiently well. Recent tests have shown that the average headlamp on the road will produce less than half its possible light output because of dirty lenses, and blackened bulbs. Then too when headlamp is misaimed, the light is not directed for best results. But a major difficulty is the failure of drivers to depress their beams when meeting other cars.

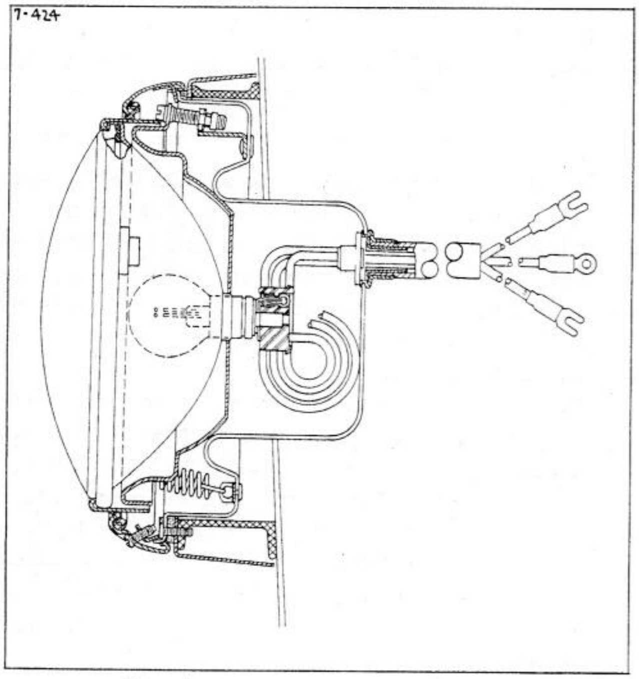


Fig. 4 Sectional View of Headlamp

Many drivers do not depress their beams through ignorance of the function of their headlamps; others do not because they are afraid they will not be able to see well enough with the lower or depressed beam; and still others refuse because of their greediness. The lower or depressed beam may not throw light far enough ahead for clear road driving, but, when another car is approaching, objects between the two cars show up in silhouette against the road. In fact, recent tests have shown that the visibility under this condition -- two cars passing with lower or depressed headlamp beams -- is sometimes greater than the clear road visibility with the upper beam.

Increased night travel, and higher potential speeds of vehicles are combining to make night driving more hazardous under ordinary conditions.

Night driving involves a different technique than day driving because of the difference in visibility and the reactions of the driver to it. Drivers should be taught night driving technique by including it in the initial training which is given. This is an added need for adequate driver training.

Since vehicle headlights are the main source of illumination for most highways, they should be maintained in good condition for best visibility and comfort for both drivers. Light beams should be depressed in meeting cars in order to reduce the tendency toward glare and to increase the illumination on the highway by silhouette for other drivers.

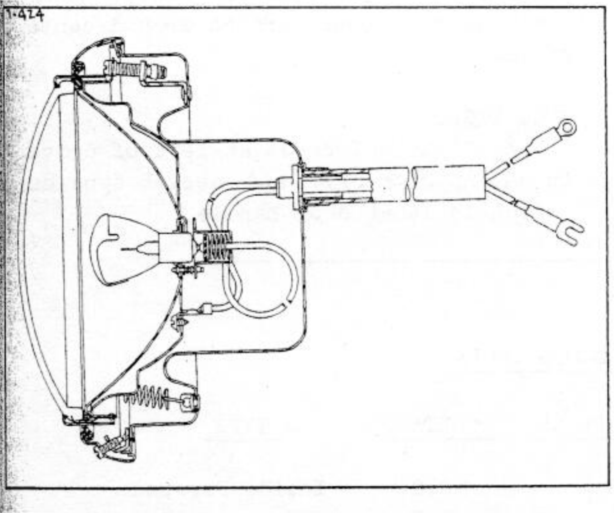


Fig. 5 Fog Light Assembly

The maximum safe operating speeds of vehicles at night are lower than those in the day-time because of decreased visibility.

HEADLAMP LENS

Dirty lenses absorb a large amount of light and therefore decrease lighting output and add to night driving hazards. Lenses are easily cleaned with water and a good glass cleaner. Inside of "Sealed Beam" headlamp lens cannot be cleaned since it is sealed to reflector and forms a complete unit.

HEADLAMP BULBS

Proper voltage must be maintained at the headlamp bulb in order to get the maximum illumination output. Such items as a low battery, poor electrical contacts in the wiring system, and poor ground through the headlamp body and its brackets and loose connections in generator to battery circuit all contribute to a loss in voltage. Illumination service demands that all of the headlamp electrical circuits be checked.

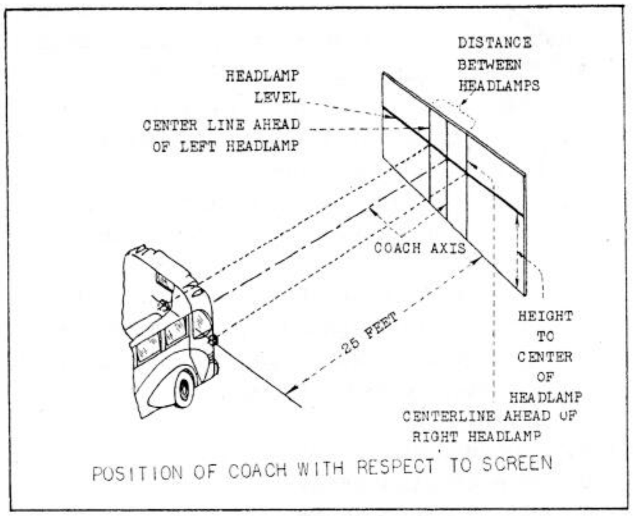

DISTANCE BETWEEN HEADLAMPS
HEADLAMP LEVEL
CENTER LINE AHEAD OF LEFT HEADLAMP
COACH AXIS
25 FEET
HEIGHT TO CENTER OF HEADLAMP
CENTERLINE AHEAD OF RIGHT HEADLAMP
POSITION OF COACH WITH RESPECT TO SCREEN

Fig. 6 Headlamp Aiming Chart

REMOVING HEADLAMP UNIT

Sealed beam unit may be removed in following manner:

1. Remove headlamp rim (remove screw "1" Fig. 3).
2. Remove three screws ("2", Fig. 3) holding retaining ring.

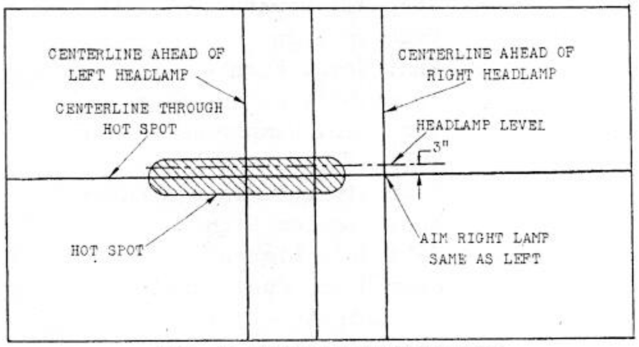

CENTERLINE AHEAD OF LEFT HEADLAMP
CENTERLINE THROUGH HOT SPOT
HOT SPOT
CENTERLINE AHEAD OF RIGHT HEADLAMP
HEADLAMP LEVEL
3"
AIM RIGHT LAMP SAME AS LEFT

Fig. 7 Headlamp Beam Pattern

3. Sealed beam unit may be withdrawn from body after plug has been removed from unit.

Entire headlamp assembly may be removed in following manner:

1. Remove headlamp rim.
2. Remove body retaining screws.

AIMING HEADLAMPS

Aiming headlamp may be accomplished accurately with a standard tester; however, if this equipment is not available, aiming adjustments may be made in following manner:

1. Place vehicle on level floor about 25 ft. from wall as shown in Fig. 6.
2. Draw horizontal line on wall chart at height of lamp center.
3. Locate point on this horizontal line at which projected center line of chassis intersects.
4. Measure distance between lamp centers and divide this distance equally on either side of center mark. Draw two vertical lines directly ahead of each lamp center as shown.
5. Remove headlamp rim on headlamp.
6. Turn on high beam.
7. Adjust upper screw ("3", Fig. 3) to raise or lower beam, and side screw to properly center beam. Adjust "hot spot" as shown on Fig. 7.
8. Repeat with opposite lamp.

FOG LIGHT

Fog lights, Fig. 5, are of type similar to headlamps except amber lens is used and bulb can be replaced by taking off lens. Fog cap is used on bulb to prevent glare from direct rays. Fog lights are controlled by push-pull switch marked "FOG" on switch panel. A foot switch located near headlamp dimmer switch permits driver to turn fog lights off and on as long as dash panel switch is turned on. Fog lights are adjusted in same manner as explained under "Head Lamps" except that "hot spot" is more concentrated around centerline of lamp.

SPOT LIGHT

Spot light is located at left of driver and is aimed with ball and socket type handle. Switch is located on handle.

LIGHT BULB DATA

LIGHT	CANDLE POWER	CONTACT	TYPE
Indirect Lights	15	S.C.	Inside Frosted
Night Lights	3	S.C.	Blue
Reading Lights	15	S.C.	Inside Frosted
Marker Lights	3	D.C.	Clear
Stepwell Light	6	S.C.	Clear
Highway Sign	6	S.C.	Clear
Eng. Comp. Lights	15	D.C.	Clear
Front Destination Sign	6	S.C.	Clear
Air Comp. Compartment Light	15	D.C.	Clear
Inst. Panel Dash Light	3	D.C.	Frosted
Rear License Plate Light	6	S.C.	Clear
Front Emblem Light	6	S.C.	Clear
Tell-Tale Lights	3	D.C.	Clear
Switch and Fuse Panel	3	S.C.	Clear
Dash Light	3	D.C.	
Stop Light	15	S.C.	Clear
Tail Light	3	S.C.	Clear
Directional Signal Light	32	S.C.	Clear
Head Light	Sealed Beam		
Fog Light	32	S.C.	Clear (Fog Cap)
Spot Light	32	S.C.	Clear
Step Light	6	S.C.	Clear
Front Door Light	6	S.C.	Clear
Side Dest. Sign	6	S.C.	Clear
Emergency Door Red Light	3	D.C.	Clear

Miscellaneous Electrical

Instructions and Illustrations in This Group Apply to Following Subjects:

Electric Speedometer
Horns
Inside Signal System
Defroster Fans
Directional Signal

MISCELLANEOUS ELECTRICAL EQUIPMENT

Descriptions and maintenance information contained in succeeding paragraphs of this group pertain to electrical equipment which is not covered in other section of this book.

ELECTRICAL SPEEDOMETER

The electric speedometer consists of a motor unit which is mounted on back of a conventional type speedometer and a drive unit which is mounted in the engine compartment. A four wire cable and plug makes the electrical connection from the drive unit to the motor unit.

Speedometer head on instrument panel is fitted with a recording device which indicates highest operated vehicle speed between settings. The instrument is provided with two hands, the conventional hand and a maximum recording hand. The recording hand is carried by the conventional hand to the highest speed reading where it remains when conventional hand returns to show lower speed reading. To take reading, or reset recording hand, it is necessary to break seal at cover lock pin, remove pin and raise cover. To reset hand, loosen check nut and turn screw. Be sure cover is sealed to prevent unauthorized tampering with device.

Drive unit in the engine compartment, is driven by means of a short flexible shaft assembly. The drive unit consists of a rotor with two brushes which run against a resistor ring gradually increasing and decreasing the current in the two pairs of coils in the motor unit behind speedometer head. The energized coil of the motor unit turns the magnetic rotor at exactly the same speed as the rotor in the drive unit, thereby, accomplishing a synchronized electrical drive in place of the conventional mechanical drive.

In servicing the electric speedometer motor unit and drive unit, utmost care must be taken that coils, wires, and connections are not damaged or handled roughly so as to avoid short circuits. Whenever either the motor unit or the drive unit is disassembled, care must be taken that the rotors which turn on ball bearings will spin perfectly free. Also when connector plugs are removed, care must be taken at reassembly to determine that split prongs make good contact. If this difficulty is encountered, it can be easily overcome by inserting small screw driver in split prong and spread slightly.

TESTING ELECTRIC SPEEDOMETER

Use Special Test Box Tool No. J-1150.

1. Be sure bulbs in test box are good by checking with battery. Also check that 6-amp fuse in feed wire from battery (or generator) is not burned out.
2. Pull four contact plug out of top of electric speedometer drive unit and insert plug on end of test box cable in its place.
3. Disconnect drive shaft at take off point at "angle drive".
4. Connect feed terminal on drive unit (terminal on side of housing near bottom) to 12-volt battery. On coaches where speedometer circuit is fed from ignition switch, it will only be necessary to turn ignition switch "ON".
   On other coaches, it will be necessary to use jumper wire to connect this terminal to battery at starter cable terminal. Refer to Wiring Diagram.
5. Turn drive shaft slowly by hand. If lights alternately grow bright and dim, drive unit is functioning properly.
6. Remove test box cable plug from drive unit

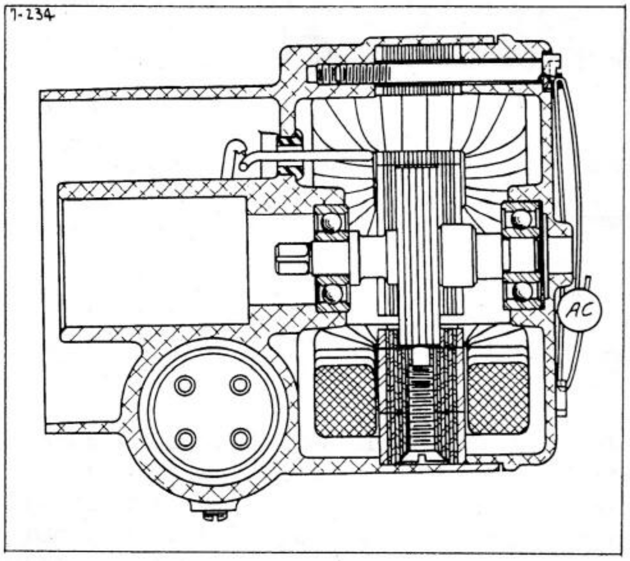


Fig. 1 Sectional View of Motor Unit.

and reconnect plug on coach cable. Disconnect cable plug from speedometer head and connect this plug to test box cable, using double end male adapter chained to end of cable.

7. Again turn drive shaft slowly by hand. If lights alternately go bright and dim, wiring between drive unit and head is O.K. and trouble should be in head unit.
8. Always be sure that plugs make good contact when connected. Best precaution is to spread split ends of male prongs slightly before connecting.
9. If lights fail to check when connected to drive unit, check feed and ground connections at drive unit for tightness. Also check to make sure that drive shaft upper tip is properly engaged with square on rotor shaft. Assembly of drive shaft to unit must be carefully made to be sure it engages properly before proceeding to tighten shaft nut to housing. Best way is to turn lower end of shaft very slowly as shaft nut is screwed into housing so that engagement can be felt as shaft goes into place.
10. If lights check O.K. when connected to drive unit but not when connected at front of cable, careful check should be made of cable for broken wire or loose connections where wires attach to sockets.

The above procedure makes it very easy to determine where the trouble lies, that is whether it is in the motor unit, drive unit or wiring.

Speedometer head and motor unit requires very little maintenance with the possible exception of inspection coupling. Therefore it is recommended that these units be left alone until there is evidence of an actual failure. When definately sure that trouble is in the speedometer unit proceed as follows:

DISASSEMBLING MOTOR UNIT

Before removing unit from instrument panel check connector plug to see that no wires are broken, also that split prongs in the motor unit are spread a sufficient amount to make good contact. Also check to make sure that rubber coupling is properly engaged. This can be done by removing the brass sealing plug back of motor unit and with a small square drive tip, spinning motor shaft and speedometer head.

1. Remove motor unit from speedometer head and check coupling to make sure that it is properly engaged.
2. Disassemble motor unit by breaking seal wire and removing screws. Cover and rotating magnet assembly can then be removed inspected and cleaned adding a few drops of light oil to the shielded ball bearings.
3. Check wiring by test lamp across the diagonally opposite prongs for the connector

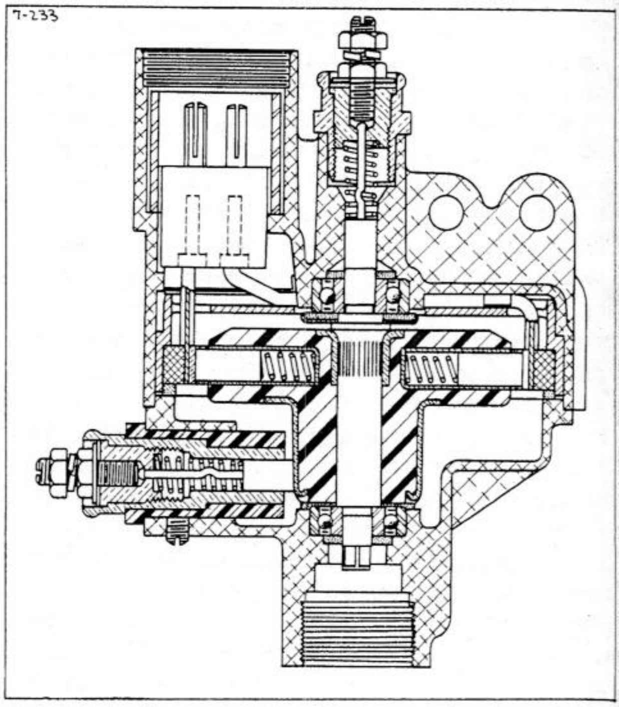


Fig. 2 Sectional View of Drive Unit.

plug. If burned out coils are found, replace with field coil and armature assembly.

REASSEMBLING MOTOR UNIT

1. When reassembling electric motor unit make certain that cover is evenly tightened and that rotating magnet assembly spins perfectly free and has from .002" to .020" end play. This may be increased by shimming up the cover from the armature assembly.
2. Before reassembling motor unit to speedometer make certain that speedometer is running free by twirling the squared end with the rubber coupling.
3. When tightening nuts on the long studs holding the speedometer to the motor unit care must be taken to tighten these evenly; also they should not be too tight or binding may result.

If speedomwter test fixture with master ead is available, the speedometer head can be tested separately from the electric motor nit at a certain given speed, perferably 60 iles per hour, and then tested connected to the electric motor unit with master speedometer reading 60 miles per hour. If speedmeter calibration is not satisfactory when peedometer is driven mechanically, this head may be recalibrated by an authorized United otors Service Station. Speedometer caliration discrepancies have no connection with the electric drive unit providing the speedometer head and motor unit are not binding hich is easily discovered by excessive ointer fluctuations.

It is recommended that electric driving nit be removed, cleaned, and inspected very 15,000 miles.

DISASSEMBLING DRIVE UNIT

· Disconnect lower end of flexible shaft from drive take-off.
2. Current to drive unit should be turned off after which disconnect live wire and ground wire; also four prong connector plug.
3. Remove drive unit from coach and remove flexible shaft from drive unit.
4. All accumulated dust and dirt should be removed from outside of drive unit. Cleaning fluid should be applied sparingly to outside of unit; do not submerge unit in liquid so as to prevent any from entering inside of drive unit.
5. Place lower part of unit gently in a vise and remove four mounting screws.
6. Remove upper half of cover amd take out rotor assembly with ball bearings.
7. Remove lower brush holder by loosening set screw. Clean lower half thoroughly removing all brush dust and wipe dry of moisture.
8. When cleaning upper half with resistor ring, do not submerge in gasoline or any other cleaning fluid but merely wipe clean with a soft cloth. Rotor should also be cleaned in same manner.
9. Inspect brushes carefully for wear. Normal wear should be approximately .0015" for every 15,000 miles. When removing brushes from the rotor inspect coil springs taking them out of square brush holder to make sure that they work perfectly free in holder and that pig tails are assembled with sufficient slack so that brushes can almost be taken out of brush holder without unfastening at pig tail. Brush spring and bushing assembly should be unscrewed from brush holder for purpose of cleaning and inspection.

REASSEMBLING

1. Hold brush in one hand and screw bushing in other hand turning the other hand counterclockwise until pigtail is untwisted. Then continue counter-clockwise approximately three turns after which the brush spring and bushing assembly is inserted into insulated brush holder making sure that the curvature at the end of the brush is properly located. Then tighten the screw bushing. This will give the proper condition of pig tails when assembled. Pull on brush and test for freeness in brush holder. Insert complete insulated brush holder in lower housing making sure that brush curvature is properly located.
2. Inspect ball bearings for freeness, applying a few drops of light oil on the bearings, also on felt washers on each side of bearings.
3. Assemble rotor in lower half of housing making sure that the live brush is free and has proper contact against commutator ring of the rotor.
4. Assemble brass retainer, large felt washer, ball bearing, and small felt washers on top of rotor applying a few drops of light oil to bearings and felt washers.

5. Assemble upper half of housing with resistor ring to the lower housing. This is easily accomplished by tipping upper half so as to engage one of the rotor brushes with the resistor ring and then gently pressing the other rotor brush into the ring with a screw driver. Care must be taken that felt washers on rotor shaft are not pinched between the step on the rotor shaft or in housings during this assembly. Replace four studs tightening evenly and snugly. Rotor should be turned with a suitable square drive tip to determine that it is running freely.

6. When reassembling flexible shaft to the drive unit, care should be taken that flexible cable tip engages upper squared tip of the cable. Flexible cable should be turned during assembly. Before connecting lower end of flexible drive shaft, drive unit should be run by mechanical means and checked at speedometer head on instrument panel to determine that it is functioning properly.

7. When reconnecting four pronged cable to drive unit, care should be exercised that connector plugs are making good contact.

HORNS

Electric horn, operated from button on steering wheel, is provided in addition to air horns operated by foot valve.

All horns are mounted under shielding hood in left front instrument compartment and are accessible from below.

INSIDE SIGNAL SYSTEM

Passenger buzzer signal is operated through switches by pull cords on each side of coach. These switches are connected to buzzer which is located on front side of instrument panel close to driver.

DEFROSTING FANS

Two defrosting fans are provided on windshield.

Electrical motors used on defrosters require very little attention. These are fractional horsepower motors of dependable construction.

Motors should be overhauled before cold weather begins. They should be inspected to see that commutators are clean and properly undercut. See that brushes are not worn down and that they move freely in their holders. Brush springs which are weak and appear burned should be discarded.

Carefully clean oil felts and renew if they are badly caked with dust and dirt.

After assembling, saturate oil felts with good grade light engine oil and check operation of unit.

Defroster fans are independently controlled by switches on header panel above drivers left hand window.

DIRECTIONAL SIGNAL

Directional signal lights, on each side of front and rear end of coach, are controlled by switch under shift lever on steering housing. Flasher type tell-tale light ahead of switch operates as long as switch is in either "Right" or "Left" hand signal position.

Engine

Instructions and Illustrations in this Group Apply to Following Subjects:

Cylinder Block and Crankcase
Cylinder Sleeves
Cylinder Head
Crankshaft
Torsion Damper
Flywheel
Crankshaft Bearings
Connecting Rods
Pistons
Camshaft
Timing Gears
Valve Mechanism
Oiling System
Engine Tune-Up
Engine Mounting
Specifications

Instructions Applying to Related Parts of Engine will be found in Following Groups:

Name	Group No.	Name	Group No.
Air Compressor	4.10401	Generator	7G.0001
Clutch	5.8401	Distributor	7D.0001
Water Pump	6.7801	Carbureter	12.8901
Fans	6.7801	Fuel Pump	12.8901
Engine Wiring	7W.0001	Air Cleaner	12.8901
Starting Motor	7S.0001	Exhaust System	12.8901
Spark Plugs	7S.0001	Lubrication	13.371

Model 707 gasoline engine instructions discussed in this group apply only to basic engine construction and do not cover allied accessories. As explained in above engine accessories are explained in other groups of this book.

Mounting instructions on gasoline engine and Diesel engine used in these vehicles are shown under "Power Plant Mounting" in this group. Diesel engine instructions are discussed in separate Diesel Manual available on request.

POSITION OF PARTS

The terms "Front" and "Rear" as used in following descriptions and instructions to designate relative position of component parts do not apply to the mounted position of engine in vehicle. Following the common usage of the terms, "Front" and "Rear", as applied to engines, "Front" is toward timing gears, and "Rear" is toward flywheel.

SPECIFICATIONS AND SERVICE DATA

Specifications listed in this group apply ONLY to gasoline engine used in this vehicle.

SERVICE BULLETINS

Service bulletins sent to the field from time to time after this book is issued, contain information important to the servicing of this engine. Bulletins which pertain to these engines should be carefully filed, and reference should be made to the bulletins when engine is serviced.

CYLINDER BLOCK

Cylinders are cast in one piece and are equipped with removable dry sleeves. Sleeves are pressed in from top of block and ground to size after installation.

INSTALLING SLEEVES

When cylinders become worn beyond a point where largest oversize pistons can be used, sleeves may be replaced with new ones, thus restoring cylinders to original diameter.

Sleeves furnished for service are selected to proper size. Block must be heated by immersing it in boiling water, and sleeves pressed in place. Minimum pressure is listed in "Specifications".

Worn sleeves may be pressed out from bottom of block or pulled out through top with screw type puller. After sleeves are pressed into place, grind to diameter shown in "Specifications" section, and fit standard size pistons and rings.

Suitable equipment should be used when grinding cylinders, and water should be allowed to circulate through block while grinding operation is in progress. Grind alternate bores (not consecutive) to prevent excessive heat build-up.

When cylinder block is removed from crankcase, gasket between the block and case should always be renewed. Tighten stud nuts down securely and uniformly.

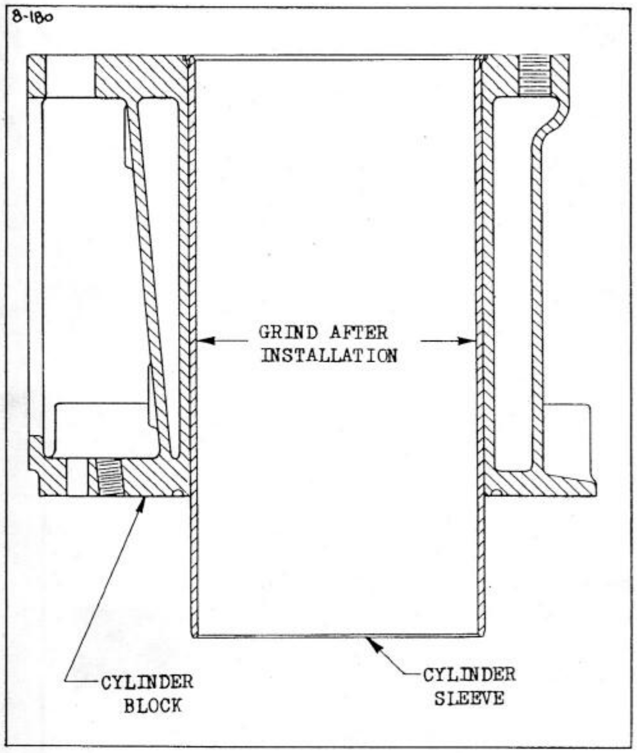


Fig. 1 Cylinder Sleeves Are Selected For Press Fit. Grind to Size After Assembly

INSPECTION

Before new pistons and pins are installed, a thorough inspection of cylinder sleeves should be made. Check for out-of-round and scored condition. Ring travel ridges should be cleaned out. If oversize pistons are used grind sleeves to clearances recommended in "Specifications" section.

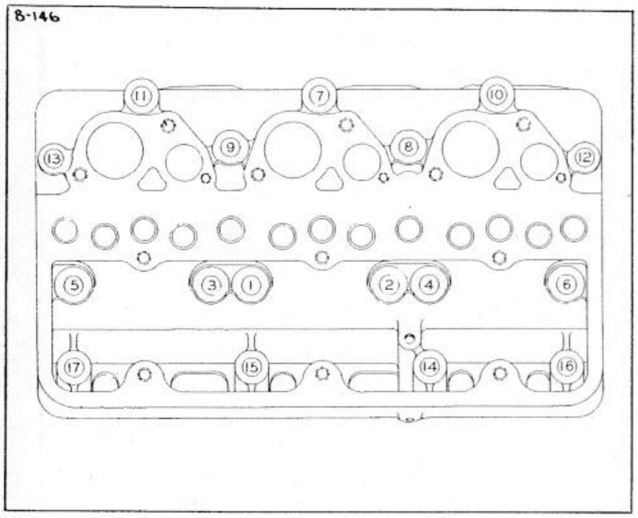


Fig. 2 Tighten Cylinder Head Nuts With Torsion Wrench in Order Shown

CYLINDER HEADS

Front and rear cylinder heads are interchangeable on same engine with or without valve mechanism attached. Each head is attached to cylinder block by special heat treated studs.

Thorough inspection should be made of cylinder head whenever removed. Inspect water jackets and remove sediment and scale. Check valve seats and stem guides for excessive wear.

Inspect cylinder head casting for cracks. Check in following manner:

1. Clean part thoroughly with benzol, gasoline, or other solvent.
2. Wipe dry.
3. Immerse in kerosene which contains a small amount of oil. Allow part to remain in kerosene solution for several minutes.
4. Remove and wipe dry.
5. Cover part immediately, by brushing or spraying, with thin coat of any liquid which will dry immediately to white coating. Thin emulsion of ZINC-OXIDE powder in wood alcohol is satisfactory.
6. Allow part to stand for few minutes. When cracks are present, brown discoloration will appear in white coating.

Before nuts are tightened, line up exhaust port pads on both heads with a straight edge. Slight clearance on studs will permit lining up the pads so that exhaust manifolds will not bind when bolted to heads.

Always use a new gasket when reinstalling head. Coat gasket on both sides with light coat of suitable sealing compound and tighten nuts.

Cylinder head bolts should be tightened in order shown in Fig. 2 and with a "Torque" or "Tension" wrench. Uniform tightening of cylinder head bolts to factory recommended tensions is essential in securing proper gasket seal. Over-tightening of cylinder head frequently causes distorted cylinder block or cylinder head, and in instances of extreme tightening, blocks and heads may crack, or studs may break or threads strip.

Irregular or under-tightening usually results in water leaks or blown cylinder head gaskets, and other damage may result from the presence of water in combustion chamber.

The recommended torque in foot pounds at which cylinder head bolts should be tightened on these engines is shown in "Specifications".

lts should be tightened to this tension, while cylinder head is cold; then run engine until head is at normal operating temperature. ive the bolts a final tightening at that ime.

CRANKSHAFT

Crankshaft, statically and dynamically balanced, and equipped with integrally forged ounterweights, is mounted in crankcase on even replaceable type bearings. Crankshaft bearing journals and crankpins are drilled o provide oil under pressure to connecting od and main bearings.

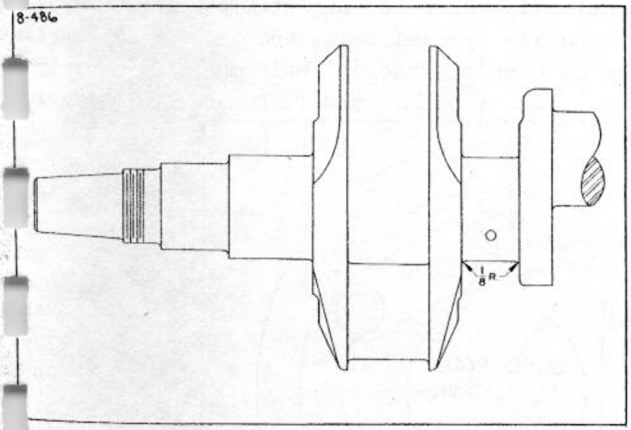


Fig. 3 Always Maintain Radius on Crankshaft Journals and Pins when Grinding

RANKSHAFT INSPECTION

When crankshaft is removed, a careful inspection should be made to determine if cracks re present. Several methods are in general se to determine the presence of cracks. The shaft may be cleaned thoroughly and examined with magnifying glass, soaked in a mixture of kerosene and oil, dryed, and painted with a zinc-oxide, or the use of "Magnaflux" method. Crankshafts showing any signs of cracks should be discarded.

Shafts should be checked for run-out by placing it on rollers or "V" blocks. Support shaft on front and rear journals and indicate center journal. If run-out is over .003", shaft may be straightened if proper equipment is used.

If shaft requires grinding for undersized bushings, a radius of 1/8", as shown in Fig. 3, should always be maintained. Standard diameters of crankshaft journals and pins are listed in "Specifications". Shafts should be ground accurately to proportionate dimensions, depending upon undersize bearings used.

Crankshafts should be stored in a manner to relieve shaft of strain due to its own weight. Store in racks constructed to support weight of shaft at several points.

TORSION DAMPER

Torsion damper, pulley, hub and fan are mounted on front end of crankshaft as shown in Fig. 4. Damper is bolted to hub and pulley by special bolts and locks. Hub is keyed to tapered end of shaft and is retained in place with hub bolt. Hub bolt is locked with two-piece lock plate.

Torsion damper, which neutralizes periodic vibrations, consists of two metal members bonded together with rubber. Torsion damper is correctly balanced as an assembly, therefore unit may be replaced without necessity of replacing hub or pulley. No attempt should be made to repair damper. If unit is damaged in any way, replace with new part.

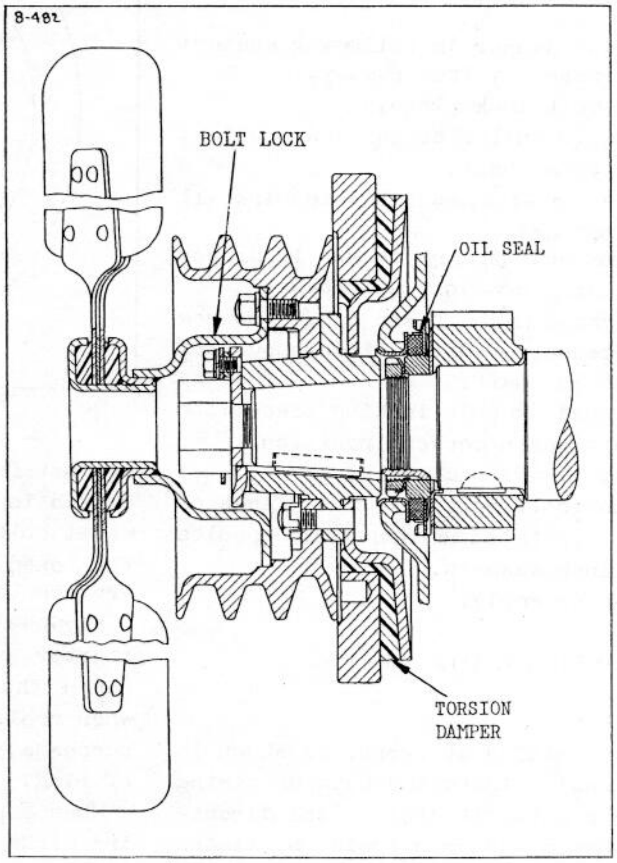


Fig. 4 Torsion Damper, Hub, Fan, and Front Oil Seal

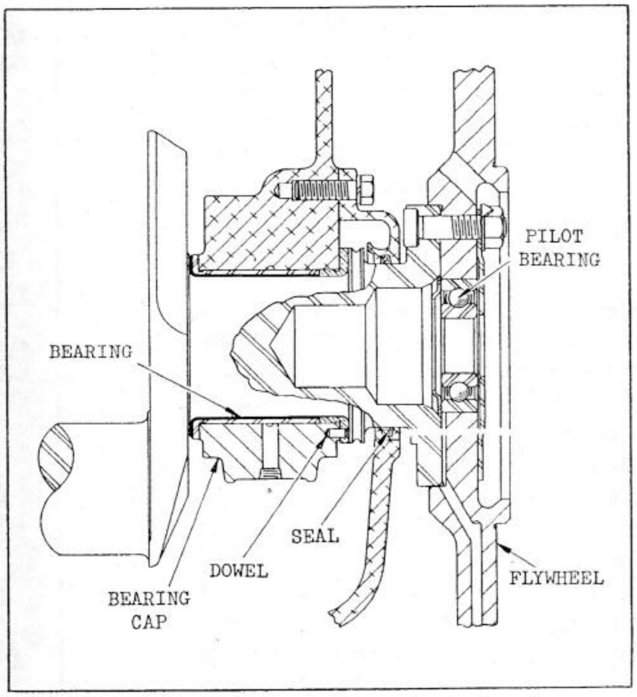


Fig. 5 Crankshaft Rear Oil Seal, Bearing and Thrust Flange

Remove hub and damper in following manner:

1. Remove fan assembly from pulley.
2. Remove hub bolt lock plate.
3. Use a suitable puller to pull hub, pulley, and damper from shaft.

If parts are replaced, assemble and install in following manner:

1. Bolt damper and pulley to hub in proper position, using new bolt nut locks.
2. Examine keyways in shaft and hub. Use new key if necessary. With suitable pusher, install hub on shaft.
3. Install tapped hub bolt locking plate with shirred portion in correct position.
4. Install and tighten hub bolt.
5. Install hub bolt retainer over faces of bolt head. Install the two retaining bolts using new lock washers.
6. Install fan assembly.

CRANKSHAFT OIL SEALS

FRONT OIL SEAL

Crankshaft is sealed at front, as shown in Fig. 4. Oil seal is installed between timing gear cover and crankshaft gear. Seal directly contacts thrust washer on inside of timing gear cover. When seal is installed between cover and gear, action of flat seal spring compresses seal assembly against cover thrust washer with sufficient pressure to prevent oil leakage. Timing cover must be removed to replace seal.

REAR OIL SEAL

Rear oil seal, as shown in Fig. 5, is inserted into grooves in cap. Oil slinger, integral with crankshaft, deflects a major portion of oil. When seals are installed, ends of seal should not protrude.

FLYWHEEL

Flywheel, on which steel ring gear is shrunk, is statically balanced, and attached to crankshaft with six special bolts and nuts. Under heads of each pair attaching bolt nuts is lock plate, lips of which are flattened against faces of nuts. See Fig. 6. Whenever clutch is removed for repair purposes, flywheel bolts and nuts should be inspected and tightened if necessary. If lips on lock plates are cracked, replace with new ones.

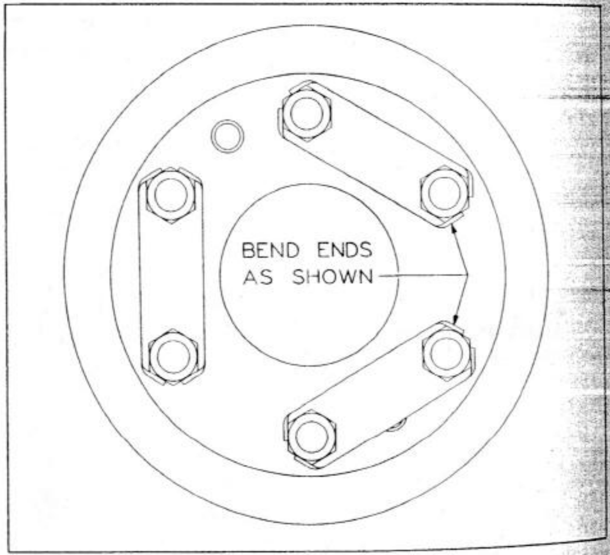


Fig. 6 Flywheel Lock Plates

Flywheel ring gear teeth are shaped to fit starter pinion; therefore, care should be taken that correct ring gear is installed when replacement is made. For identification purposes, the word "Dyer" is stamped on side of ring.

When replacing flywheel, always check timing marks on new wheel with those on removed part. In some instances, flywheels are furnished for service replacement without ignition timing marks; therefore, foregoing service procedure is necessary when replacement is made.

Rear surface of flywheel (to which clutch plate is attached) should be checked for run-out after ring gear is shrunk in place. Run-out on this surface should not exceed .003" total indicator reading after flywheel is installed on crankshaft.

Flywheel is provided with grease passage so that clutch shaft pilot bearing can be lubricated. Lubricate bearing in following manner: (See Fig. 7.)

1. Remove timing hole cover and turn flywheel until pipe plug is accessible.
2. Remove pipe plug and install a standard lubrication nipple in its place.
3. Apply small amount of lubricant only. (See Lubrication chart.) If too much lubricant is used, excess will be forced through seal on to clutch plates.
4. REPLACE LUBRICATION NIPPLE WITH PIPE PLUG.

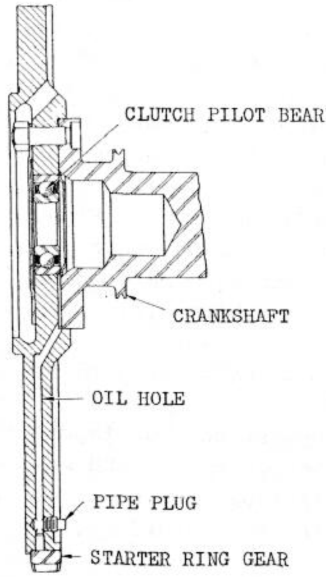


Fig. 7 Method of Lubricating Clutch Pilot Bearing

CRANKSHAFT BEARINGS

Crankshaft bearings are replaceable precision type, which when clamped in place in correct manner, provide proper clearance without reaming, boring, or scraping. Upper and lower halves are equipped with notches on one edge of each shell which fit into corresponding recesses or notches in cap and support. See Fig. 8.

Thrust is taken on flanges of center bearing. Clearance limit is shown in "Specifications" section.

INSTALLING AND FITTING CRANKSHAFT BEARINGS

Complete set of seven bearing assemblies should be used when replacement is made. Crankshaft bearings can be installed without removing crankshaft. Upper half of bearing can readily be removed after cap has been taken off, by turning crankshaft in opposite direction of engine rotation. As crankshaft is turned, tap plain edge of bearing shell lightly to start it rolling around shaft. Bearing is installed in reverse manner.

Inspect and check crankshaft journals before installing new bearings. If journals are out-of-round or scored, they must be reground to dimension shown in "Specifications" section to fit undersize bearings.

Following procedure should be used when installing or fitting new bearings:

1. Remove and install one set of bearings at a time. Clamping surfaces of cap and support must not be marred.
2. Install upper half as previously instructed. Make sure that lock in one side of bearing fits into notch in support. See Fig. 8.
3. Install lower half in cap so that lock fits snugly into notch in cap.
4. Three .002" shims on notch lock side of bearings are used when making first fit. Do not use shims on opposite side. Shims must not project over edges of bearing shells.

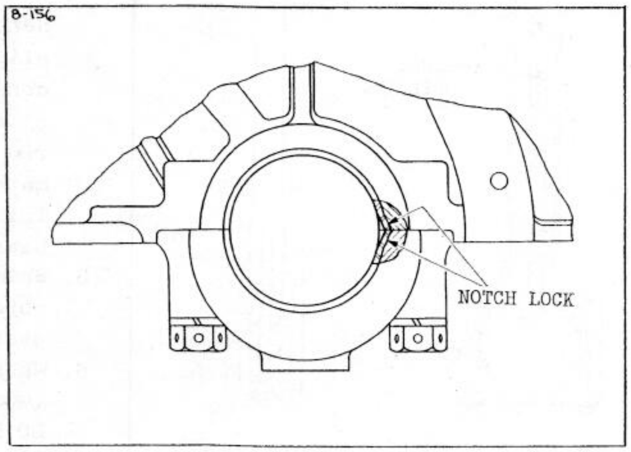


Fig. 8 Locks in Both Halves of Bearing Fit in Notches in Crankcase and Cap

5. Tighten bearing cap nuts with a torsion or tension wrench. Fit the wrench to ft. lbs. torque listed in "Specifications".
6. If bearings are too loose after bolts are drawn up, replace two .002" shims with one .003" shim. Repeat operation, removing .001" at a time until proper clearance is obtained. See "Specifications" section.
7. Do not use shim pack over .006" thick on new bearings. When bearings have been compressed, addition of shims will cause loose fit.
8. DO NOT MACHINE OR FILE FACES OF CAPS OF BEARINGS.

Main bearing fitting operation is an important procedure; and considerable care and accuracy are required in fitting them so as to obtain the maximum service from bearings.

CONNECTING RODS

Connecting rods are I-beam section and are rifle drilled to provide lubricant under pressure to piston pins. Oil hole in lower bearing registers with hole in crankshaft pin at each stroke, thus forcing oil at full pressure through rifle drilling to pin. See Fig. 9.

Upper end of rod is fitted with bronze piston pin bushing, reamed to correct size after installation. Lower bearing consists of two interchangeable halves of replaceable precision type. All rods in each engine are weighed and held within close limits to secure correct balance.

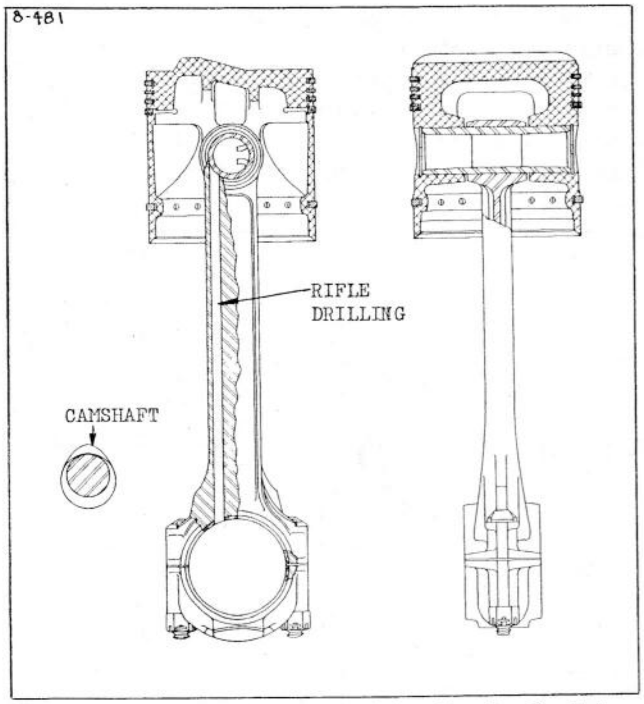


Fig. 9 Connecting Rod and Piston Running Position

REMOVING CONNECTING RODS

Piston and connecting rods are withdrawn through top of cylinder after cylinder head has been removed.

CONNECTING ROD BEARINGS

Connecting rod bearings are replaceable precision type which do not require reaming, scraping, or filing when bearing halves are properly fitted to crankpin.

Both upper and lower halves are interchangeable and must be replaced when new bearings are used. Bearings may be installed without removing connecting rod and piston assembly.

FITTING CONNECTING ROD BEARINGS

Proper fitting of connecting rod bearings requires accuracy and care. Parts should be thoroughly cleaned and wiped dry before any attempt is made to fit bearings. Instructions given below should be carefully followed:

1. Precision type replaceable bearings cannot be scraped, reamed, filed or burnished. If clearance is excessive with standard size bearings, crankpins must be reground to size shown in "Specifications" for undersize bearings.
2. Bearings must be fitted with connecting rods in "running" position. See Fig. 9.
3. When installing bearings in caps and rods make sure that lock in each bearing half fits snugly in corresponding notch on cap or rod.
4. Whenever bearings have been removed from rods during process of repair, it is essential that both halves be spread open slightly before they are reinstalled. When connecting rod bolt tension is relieved, ends of bearing tend to spring away from rod or cap. Spread both halves approximately 1/64" more than bore of rod and cap. This procedure is not necessary when new bearings are installed.
5. Shims are used only on side of rod opposite notch-locks. These shims must not project over edges of bearings.
6. When fitting new bearings, start with three .002" shims on side opposite notch-lock. DO NOT USE SHIMS ON NOTCH LOCK SIDE.
7. Tighten connecting rod bolt nuts with torsion wrench. See "Specifications" for

proper torsion setting of wrenches.

8. Proper clearance limits are listed in "Specifications". If bearing is too loose after bolts are tightened, replace two .002" shims with a .003" shim. Repeat this operation, removing .001" at a time until proper fit is obtained.
9. Do not use over .006" shim pack, and never add shims after bearings have been compressed. If shim thickness is increased, the bearings will be loose in rods.
10. Do not file or machine faces of rod, cap, or bearing.
11. After bearings are finally fitted, apply generous supply of clean engine oil on surface of bearings and crankpins.

INSTALLING CONNECTING RODS

As previously stated, rods are rifle drilled to provide lubrication to piston pin. The following procedure should be used when installing piston and connecting rod assemblies:

1. Piston must be installed on rod in running position as shown in Fig. 9.
2. If rods are numbered, they should be reinstalled in the same bore from which they were removed. Service replacement rods are not usually numbered and should be properly marked when installed.

PISTONS

Pistons are aluminum alloy with single vertical slot in skirt opposite thrust face of piston. All pistons are cam ground to the desired eccentricity at top of skirt and this eccentricity is reduced progressively so that it is substantially greater at bottom of skirt. This operation is an added refinement which gives a more uniform bearing with minimum friction, and has been carefully developed for these engines.

As cam grinding operation requires special equipment, it is recommended that finished pistons, as furnished from Service Division, be used for replacement. "Specifications" section lists available oversize finished pistons.

GRINDING SEMI-FINISHED PISTONS

If semi-finished pistons are used, they should be ground in following manner:

1. If conventional parallel cam grinding equipment is used, it will be satisfactory to grind the pistons from .003" to .004" eccentric with the smallest diameter in line with the piston pin bosses.
2. Turn piston .010" to .015" larger than cylinder size.
3. Recenter open end carefully.
4. Grind on centers to recommended diameter (standard piston) as shown in "Specifications" section.
5. Break sharp edges on ring lands with file and remove boss at top of piston.
6. Complete vertical slot at top and bottom of skirt.

CAUTION: Clearances as shown in "Specifications" section have been carefully worked out in tests at the factory and in actual service.

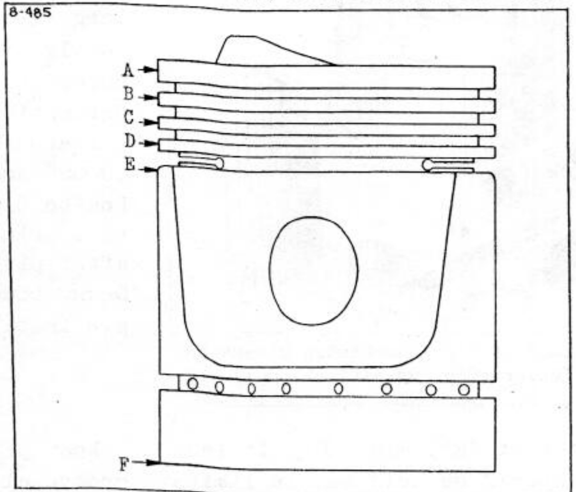


Fig. 10 Clearance Points on Pistons (See "Specifications")

These clearances are minimum; therefore, do not attempt to fit with less clearance.

FITTING PISTONS

Cylinder sleeve bores should be carefully indicated and refinished if necessary before attempt is made to fit pistons. Bores should be free from scores and not out-of-round or tapered.

If bores do not require refinishing, make sure that ring travel ridge at top of each sleeve is removed.

Pistons should be fitted in following manner:

1. Check cylinder sleeves for out-of-round and scored condition. Clean up scores with hone to obtain smooth finish.
2. Pistons and bores must be perfectly clean before attempting to fit them.
3. Pistons should be fitted at a room temperature of 68° F. to 72° F.
4. Single slotted pistons are tapered. Diam-

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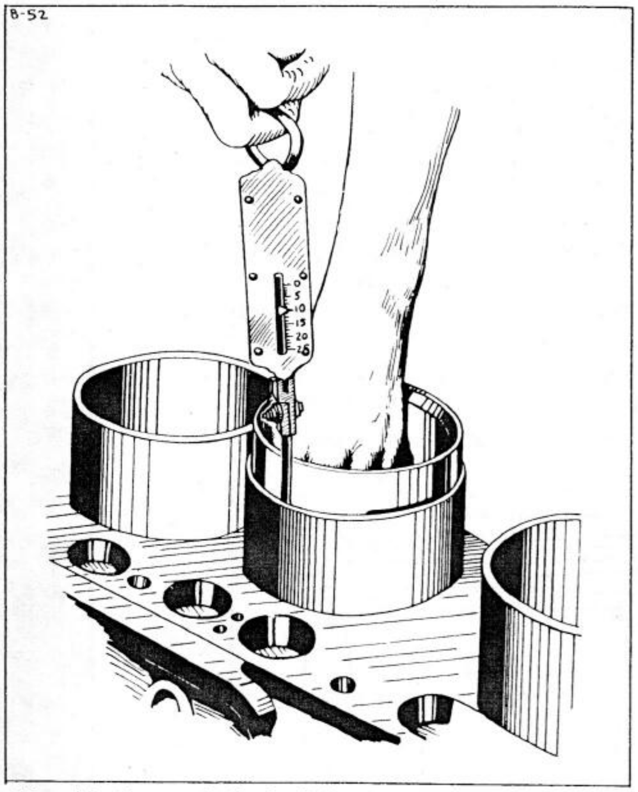


Fig. 11 Proper Method of Checking Piston Clearance With Scale and Feeler (See "Specifications")

eter of piston at "E", Fig. 10, is less than "F", and should be held within limits shown in "Specifications" section.

5. Piston must be assembled in cylinder in running position, as shown in Fig. 9.
6. Proper size feeler should be inserted vertically between cylinder wall and piston (opposite slot in skirt). Feeler ribbon must be exactly 90° from piston pin hole (midway between holes) and in line with surface of piston, see Fig. 11. Size of feeler and amount of force necessary to withdraw feeler are listed in "Specifications" section.
7. After pistons are fitted, they must be installed in cylinders to which they have been fitted.

PISTON PINS

Piston pins are tubular type, held in place in piston bosses by snap rings which are a tight fit in end of bosses.

Particular care should be used when installing snap rings. Use long-nose pliers to contract them, and make sure that they fit snugly in grooves. Do not force in or out of grooves with a screwdriver. When snap rings are installed in grooves correctly, they cannot be turned with the fingers.

FITTING PISTON PINS

Dimensions of standard pin as well as list of oversizes available are shown in "Specifications" section.

When installing connecting rod upper bushings, install so that hole in bushing registers with hole in rod. Ream to size after assembly. Ream connecting rod upper bushing to dimensions shown in "Specifications" section for standard size pin or proportionately larger for oversizes. If pin is fitted correctly, it will slide through bushing slowly under its own weight. Pin must not have any perceptible up and down movement.

Piston pin bosses must be reamed .000" to .0002" smaller than pin diameter. Heat piston to 210° F. by placing it in boiling water. Pin must be pressed into place quickly after piston is withdrawn from boiling water. Do not touch surface of pin with hands. After pin installation, fit snap rings into place.

PISTON RINGS

New piston rings should be fitted with groove clearances and end gaps as specified in "Specifications" section. Grooves in pistons should be free from carbon formation and should show no perceptible wear.

Fit new rings in following manner:

1. Place ring in cylinder, pushing it down about halfway into bore. With ring square with cylinder walls, measure gap between ends.

   NOTE; Refer to "Specifications" for type of rings used. Various type joints are used and considerable care should be taken to place correct rings on pistons.
2. If gap is less than that listed in "Specifications" section, remove ring, and dress edges with fine-cut file until proper clearance is obtained.
3. Roll back side of ring around its respective groove on piston. Ring should roll free but not loose or "sloppy". After rings are installed on piston, final groove clearance should be checked with proper size feeler indicated in "Specifications" section. Rings should be selectively fit to each individual bore and piston groove.

When piston and ring assembly is installed in cylinder, gaps in rings should not be in line vertically, nor should there be any gaps over piston pins. Stagger ring gaps so that they will be equally distant around circumference of piston.

CAMSHAFT

Camshaft is supported in case on five bronze, four of which are held in place with dowels and reamed after assembly. Front bearing is flanged and held in place with three countersunk screws, which should be staked securely to prevent loosening. Front bearing is reamed to size before assembly. Reaming dimensions are shown in "Specifications" section.

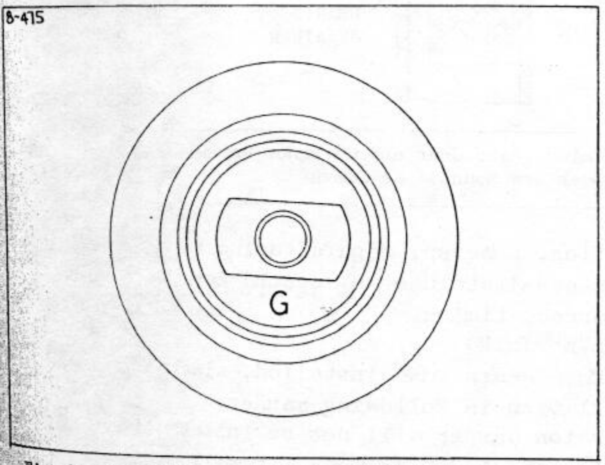


Fig. 12 Camshafts are Marked With Identification Letter - See "Specifications"

Engine in this coach runs COUNTER-CLOCKWISE. Camshaft from a clockwise engine of same type cannot be used. For identification purposes, camshafts used in these engines are stamped with a letter. Refer to "Specifications" for correct letter identification. Make sure that correct camshaft is used. See Fig. 12.

REMOVAL

Camshaft may be removed in following manner:

1. Remove oil pan, push rods, tappets, guides and timing gears.
2. Remove three flat head screws from front bearing flange. Slide shaft toward flywheel far enough to expose set screw in oil pump drive gear. See Fig. 13.
3. Remove set-screw wire and take out set screw.

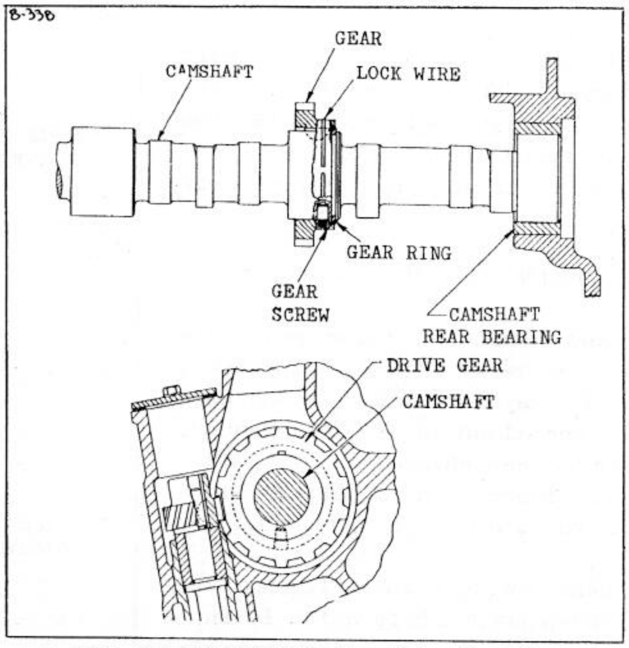


Fig. 13 Camshaft Oil Pump Drive Gear is Assembled to Camshaft as Shown

4. Move oil pump gear forward on shaft until ring can be removed.
5. Move oil pump gear still farther on shaft and take out Woodruff key. Camshaft can then be removed through front end of the crankcase.

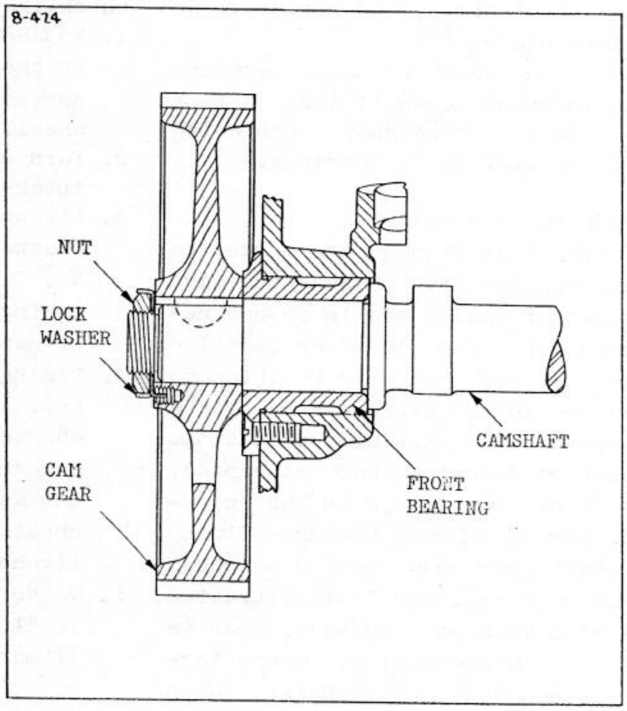


Fig. 14 Camshaft Gear is Keyed to Camshaft and Held in Place With Special Nut and Lock

INSPECTION

When camshaft has been removed for repairs inspect cam faces. Cams should show no appreciable wear. All journals should be free from scores and round within .002".

Clean oil grooves in bearings before shaft is reinstalled.

TIMING GEARS

Crankshaft and camshaft timing gears are metal type and are keyed in proper location. Camshaft gear is keyed to camshaft and held in place with special nut and locking washer. Locking washer is cup-shaped and fits into recess of gear. Tongues on washer are flattened against faces of retaining nut. See Fig. 14.

Idler gear meshes with crankshaft gear, and is mounted on independent shaft which is supported by annular ball bearings, as shown in Fig. 15. This idler gear drives water pump and distributor drive shaft gear. It also drives governor through gear keyed to its shaft.

REMOVING AND INSTALLING GEARS

Particular care should be used when removing and installing timing gears. Proper pullers and pushers should be used to prevent damage to gears and shafts. Do not drive or force gears into place.

When reinstalling camshaft gear, examine nut retaining lock and renew if lips on lock are cracked. Always renew snap rings which retain rear idler gear shaft bearings.

LOCATION OF TIMING GEAR MARKS

Crankshaft and camshaft gears are marked to indicate proper engagement. These gears must be installed so that shafts are in proper relation to each other. Fig. 16 shown location of marks on both timing gears in relation to their respective keys. Marks on new gears should be compared, if possible, with those on old gears before installation is attempted.

Camshaft gear has two keyways in hub located so as to permit closer timing. Timing marks on camshaft gear are located as shown in Fig. 16, and mark as shown in illustration which aligns with mark on crankshaft gear is one generally used in production. Gears furnished for service will have both marks. When new camshaft gear is being installed, it is recommended that installation be made as shown in illustration. However, manufacturing tolerance may necessitate use of second keyway to obtain correct timing.

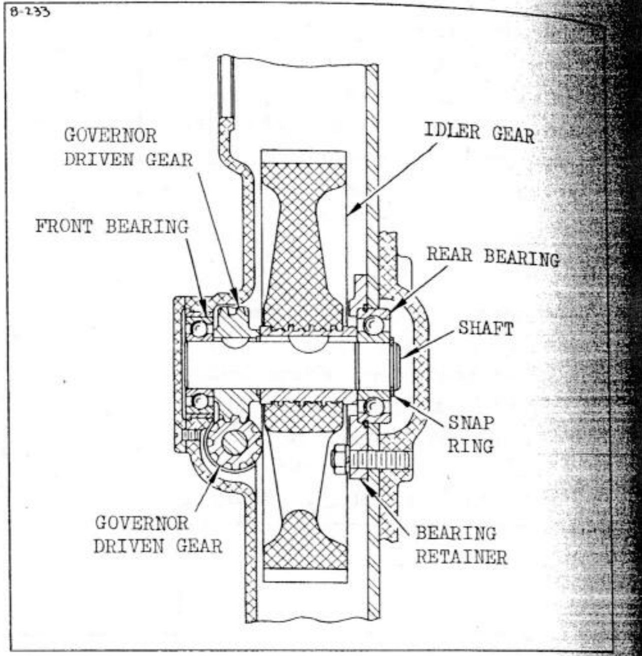


Fig. 15 Timing Idler Gear and Governor Drive Gear are Mounted as Shown

CHECKING VALVE TIMING

After timing gears are installed, always check installation in following manner:

1. As the torsion damper will not be installed at the time this check is made, it will be necessary to use timing marks on the flywheel. See Fig. 17.
2. Turn engine counter-clockwise until No. 6 intake valve is completely closed.
3. Attach dial indicator to rocker shaft bracket allowing indicator pin to rest on No. 6 intake valve adjusting screw. After making certain that valve tappet is on base of cam, set indicator at "zero".
4. Timing point is .008" above base center of cam. Therefore, timing point is reached when camshaft has been turned just far enough to raise tappet .008" on base of cam as shown on indicator. Dial indicator should register .008" when "I.O." mark on flywheel is directly in line with pointer.
5. Valve timing may be considered satisfactory if "I.O." mark is within 1/4" of pointer. If mark is more than 1/4" on either side of pointer (on flywheel only) when dial indicator reading is .008", reinstall camshaft gear properly marked for use of tim-

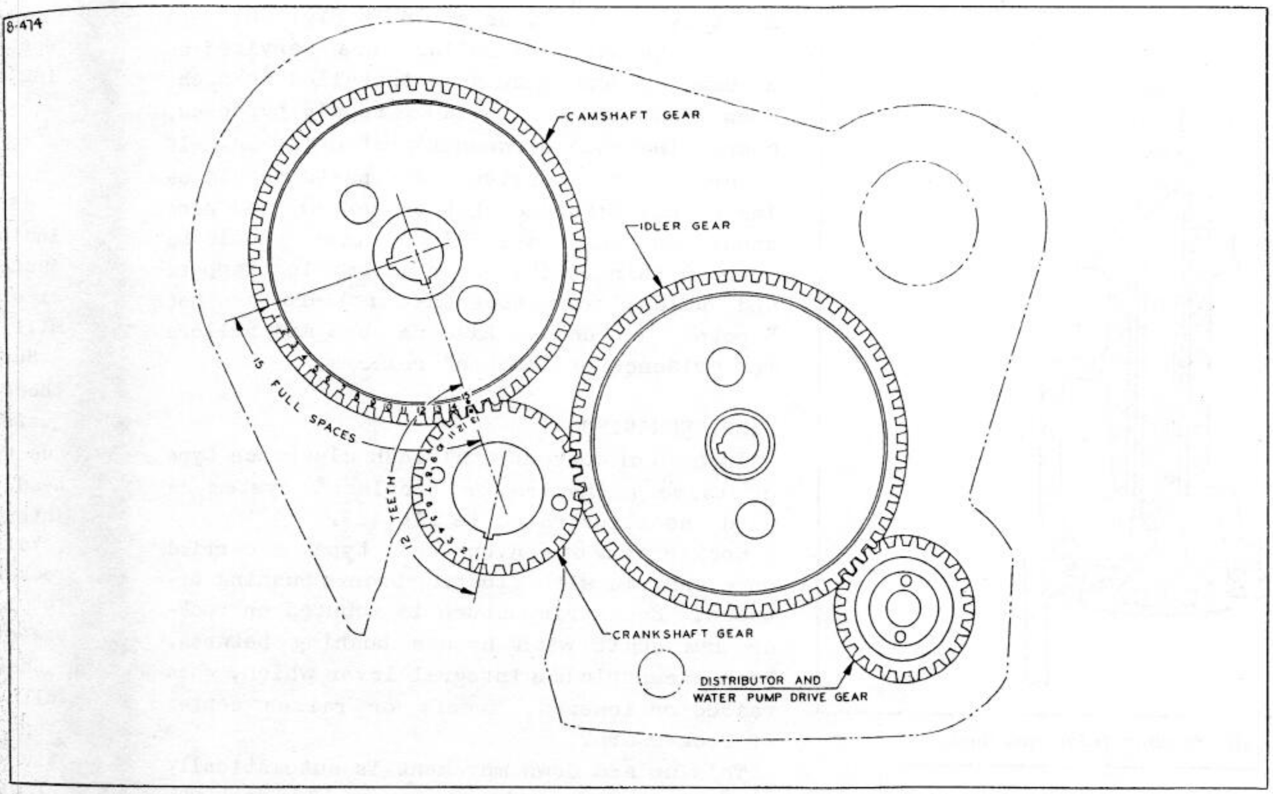


Fig. 16 Timing Gear Train Showing Marks on Crankshaft and Camshaft Gears

ing mark and again check with dial indicator.

6. After reinstalling timing gear cover, install balancer as directed on preceding pages under "Torsion Damper".

VALVES

Intake valves are one-piece. Exhaust valves are special sodium filled type, as illustrated in Fig. 18. Valve stem is sodium-filled, which assists in rapid dissipation of heat from valve head. No attempt should be made to repair these valves. Exhaust valves are tipped with special hard material.

VALVE STEM GUIDES

Valve stem guides are pressed into cylinder head and reamed to size after installation. Clearance between valve stems and guides should be checked whenever valves are removed for repair purposes, and if found to be excessive, new guides should be installed and reamed to size indicated in "Specifications" section.

VALVE SPRINGS

Two springs, inner and outer, are used on each valve. Lower ends of these springs rest directly on cylinder head casting, while at upper end, cap and split retaining keys are used to hold valve stems and springs.

Suitable spring compressing tool should be used to remove or install spring retainers. Before springs are reinstalled, they should be carefully checked against specifications given.

VALVE SEATS

Intake valve seats are integral with cylinder head while exhaust valve seats are removable. Exhaust valve seats are composed of a facing of extremely hard material welded to rings, which in turn, are threaded into cylinder head, as shown in Fig. 18, and locked

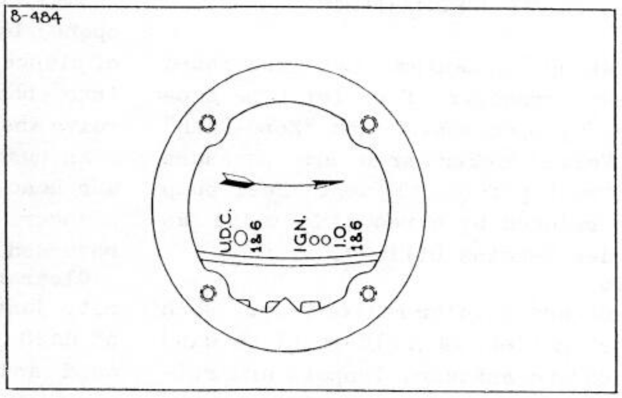


Fig. 17 Timing Marks on Flywheel

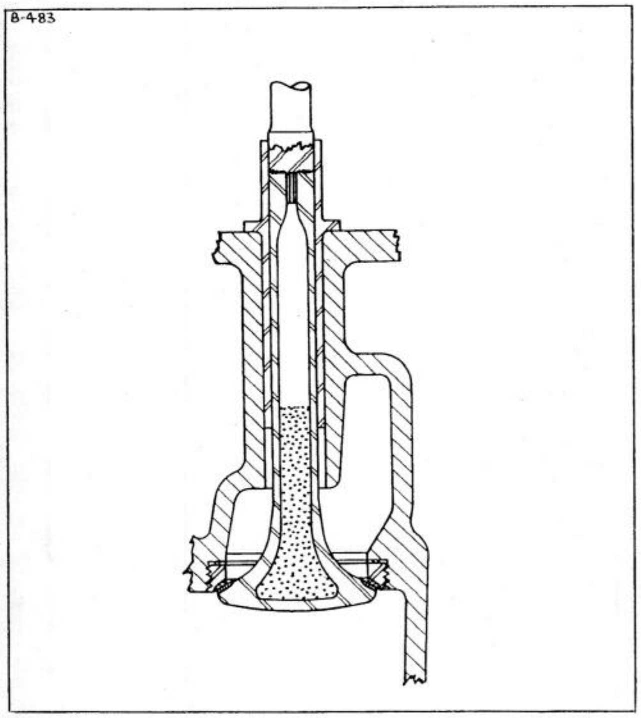


Fig. 18 Exhaust Valve and Seat

in place by staking at four points.

SEAT MAINTENANCE

As installation of exhaust valve seats requires special facilities, it is recommended that cylinder heads be replaced whenever exhaust valve seats are damaged beyond refacing operation. It is necessary to heat the cylinder head to about 200° F. and chill seats thoroughly with "dry-ice" before installation can be accomplished.

Intake valve seat may be refaced with conventional refacing tools, while the refacing operation on exhaust valve seat requires special grinding equipment or lapping tool.

VALVE MECHANISM

Valve operating mechanism is illustrated in Fig. 19 and consists of roller type tappets, push rods, rocker arms and "Zero-Lash" mechanism. Valve rocker arms are pressure lubricated directly from oil pump. Fuel pump pressure is reduced by a reducing valve as explained under "Engine Oiling".

VALVE TAPPETS

Valve tappets are tubular roller type. Each pair of tappet guides is held in place with clamp attached to crankcase. Tappets and rollers are held in constant contact with camshaft by a spring, as shown in Fig. 20.

Valve tappets and rollers are serviced as assemblies and should be installed as such. When mechanism is removed for repair purposes, check clearance between tappet and guide. If clearance is excessive, new parts should be installed. Clearance between rollers and pins should not exceed .002" and pins should be round within .001". When assembling tappets and guides, make sure that rollers are not "cocked" on cams. Examine cams and rollers for evidence of "cocked" rollers.

LASH MECHANISM

Instead of conventional lash clearance type of valve mechanism, a "no-lash" system is used, as illustrated in Fig. 19.

Rocker arms of conventional type are carried on eccentric with floating bronze bushing between. Eccentric in turn is mounted on rocker arm shaft with bronze bushing between. Each eccentric has integral lever which, when raised or lowered, lowers or raises center of rocker arm.

This up and down movement is automatically controlled by small plunger and dash pot mounted in rocker shaft support bracket immediately under eccentric lever. While valves are closed, rocker arms carry no load; therefore, springs beneath adjuster plungers provide sufficient force to turn eccentric and hold rocker arms in their lowest position, thus taking up all clearance between arm and valve stem.

Resistance to load thrown on eccentric lever when valve is opened is provided by column of oil under adjuster plunger in dash pot. Dash pot above body of plunger is kept full of oil by overflow from pressure lubricated rocker arm.

Small check valve at bottom of plunger is opened by vacuum operated by upward movement of plunger, allowing oil to flow through valve into chamber beneath it. Spring closes check valve when upward movement of plunger ceases.

As push rod raises to open valve in cylinder head, rocker arm eccentric tends to push plunger down into dash pot. This action is retarded by oil in dash pot below plunger.

Clearance between plunger and dash pot permits just enough seepage of oil from bottom of dash pot to allow plunger to push downward and compensate for expansion of parts as engine warms up. This slight downward movement is not perceptible when push rod is operating and does not interfere with opening of valve.

INSPECTION

Rough or noisy operation of engine may indicate improper functioning of valve adjuster plunger, causing eccentric to oscillate excessively. Under such conditions, valves will not open or close properly.

Such faulty action may be caused by plunger check valve not seating properly, or by adjuster plunger cylinder becoming air bound due to supply of oil in dash pot being below head of plunger, permitting air to be drawn into dash pot.

Valves riding or excessive backlash between rocker arm and valve stem can usually be traced to plunger binding in dash pot. Replace plungers or dash pot if excessively scored.

Check to see that adjuster dash pots are full of oil when engine is at idling speed. Stop engine, and press down on plunger check valve stem with bent wire inserted in plunger release hole. Continue to hold check valve off its seat for a few seconds to allow oil to flow into dash pot beneath plunger.

If foregoing test does not correct condition, dirt or other foreign matter may be lodged on face of check valve. Plunger should be removed and cleaned.

REMOVING AND INSTALLING PLUNGER

Remove adjuster plunger in following manner:

1. Make sure that valve is closed completely.
2. Hold valve spring down, and rotate rocker arm eccentric by hand until plunger can be withdrawn past eccentric lever.

When installing plunger, hold check valve stem down with wire so that oil will not prevent plunger from going down far enough into dash pot.

TESTING PLUNGER

Plunger may be tested by simply drawing air through it to determine if valve will open with suction.

SERVICING PLUNGERS

Adjuster plungers are self-contained assemblies and are serviced only as such. Plungers must be handled with care and should not be removed from original cartons until they are used.

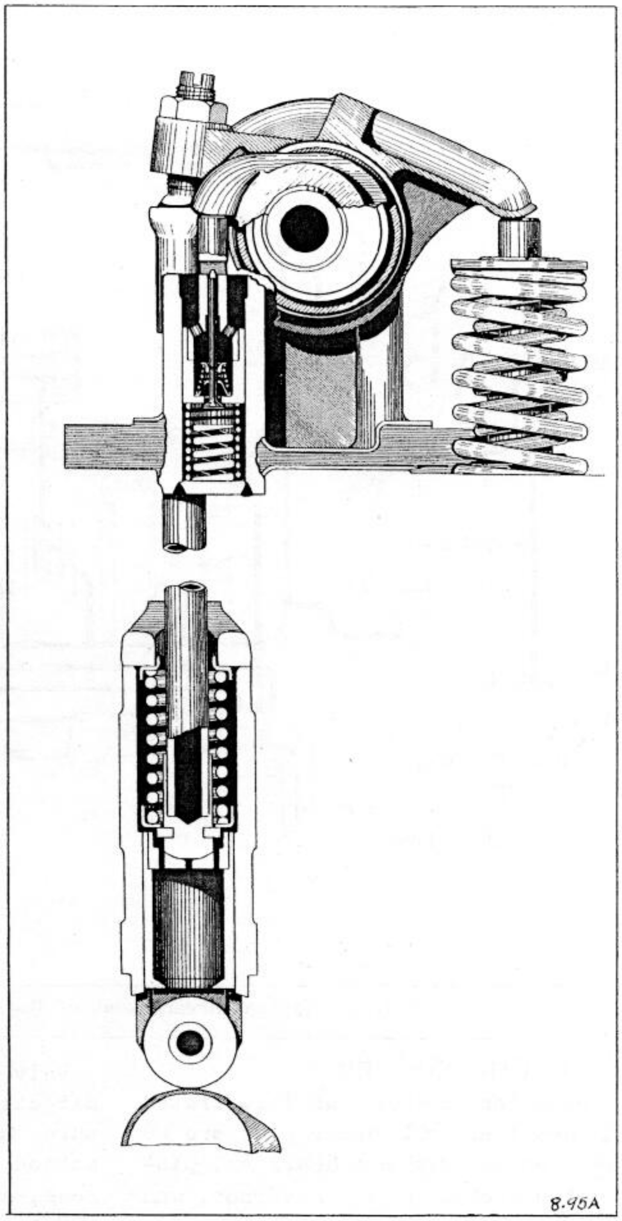


Fig. 19 Valve Operating Mechanism

INITIAL VALVE ADJUSTMENT

Rocker arms are fitted with threaded ball studs for initial adjustment of mechanism after assembly. This adjustment locates eccentric at proper angle and governs selective position of adjuster plunger in its dash pot.

Turn engine until valve closes. While making valve adjustments, adjuster plungers should be tested to make sure that they work freely in cylinders. Adjust rocker arm ball stud until lower edge of release hole in plunger stem is even with top edge of dash pot.

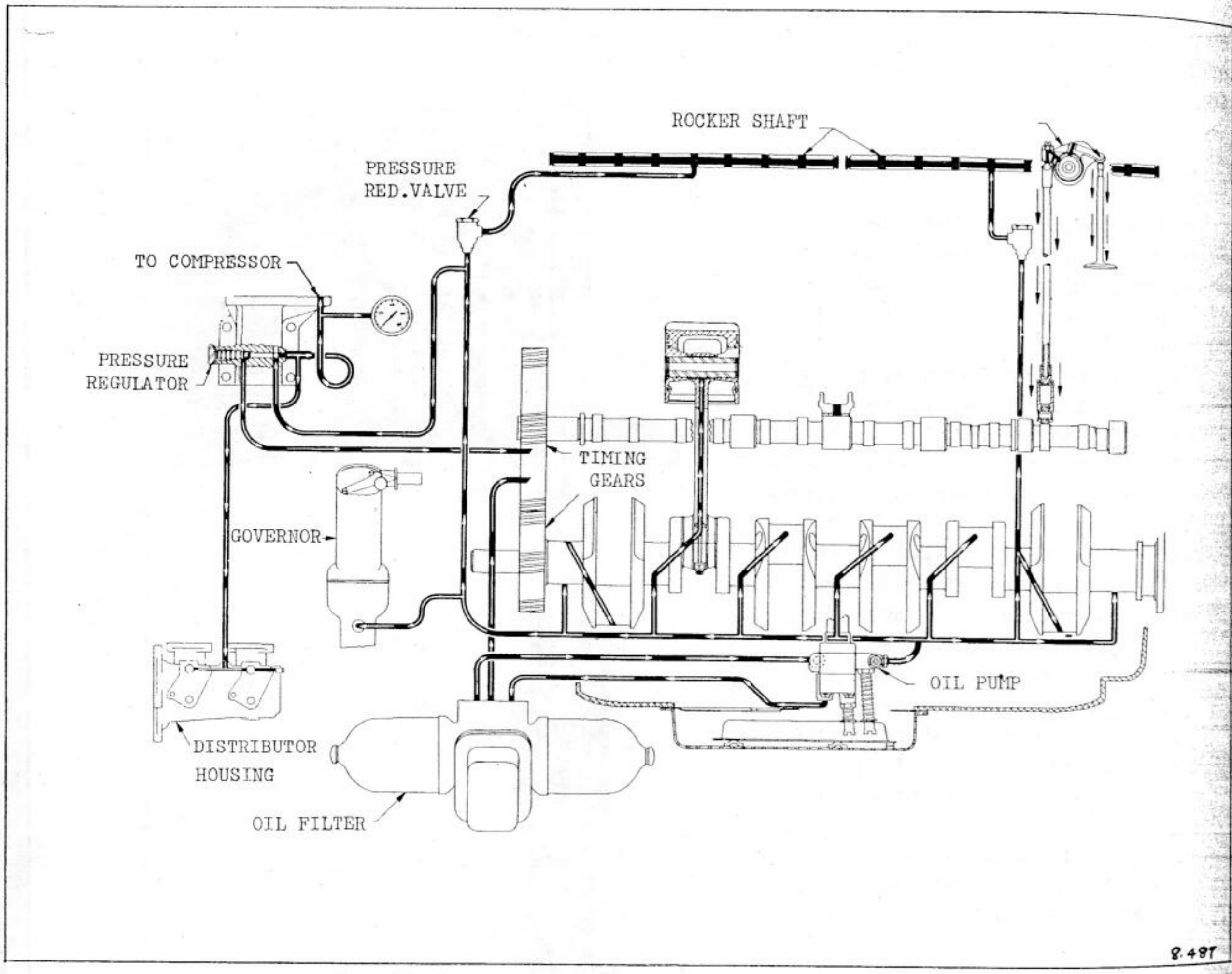


Fig. 20 Typical Arrangement of Engine Oiling System

Oiling System

Engine lubrication system, as illustrated in Fig. 20, provides oil under pressure to main bearings, connecting rod bearings, piston pins, valve rocker arms, governor, and air compressor.

Crankshafts, and connecting rods in engine and air compressor are drilled, providing oil under pressure to connecting rod bearings and piston pins of both units.

Pistons, tappet rollers, and oil pump drive gears are oiled by spray from crankshaft.

Camshaft bearings are lubricated from oil reservoirs cast in crankcase directly above each bearing. Oil reservoirs are supplied by return flow from rocker arm shafts. Push rods and tappets are also lubricated by return flow from rocker arm shaft, draining down push rods to tappet guides from oil reservoirs above tappets.

Valve rocker shafts are pressure lubricated directly from pump; however, full pump pressure is reduced to approximately 5 lbs. by action of reducing valve located at cylinder head, as shown in Figs. 20 and 21.

LUBRICATION

In placing a new or overhauled engine in operation, it is recommended that oil be changed at 500 mile intervals for the first 2000 miles of service. Thereafter, regular oil changing periods are dependent upon type of service to which engines are subjected. Periodic inspection of condition of oil should be made and oil changed whenever it is thin, or dirty regardless or mileage. Oil should be maintained at proper level at all times.

Lubrication section specifies viscosities of oil to be used at various atmospheric temperatures. These specifications are the result of practical experience and research.

and therefore, should be followed closely. No attempt has been made to recommend any particular brand of oil, however, it is recommended that only oil of known reputation be used.

OIL FILLER

Oil filler neck is mounted on air compressor base as shown in Fig. 22. This illustration shows filler neck and engine oil gauge ("1"), oil dip stick ("2"), oil cooler ("3"), oil filter drain plug ("4"), and oil pressure regulator ("5").

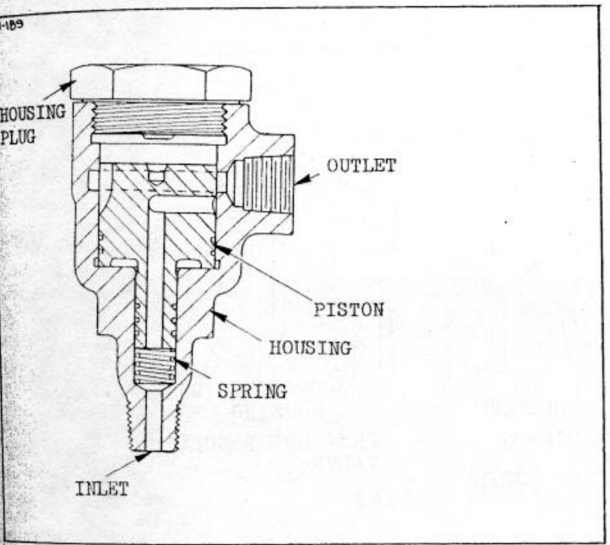


Fig. 21 Oil Pressure Reducing Valves are Located in Each Rocker Arm Fuel Line

OIL PAN

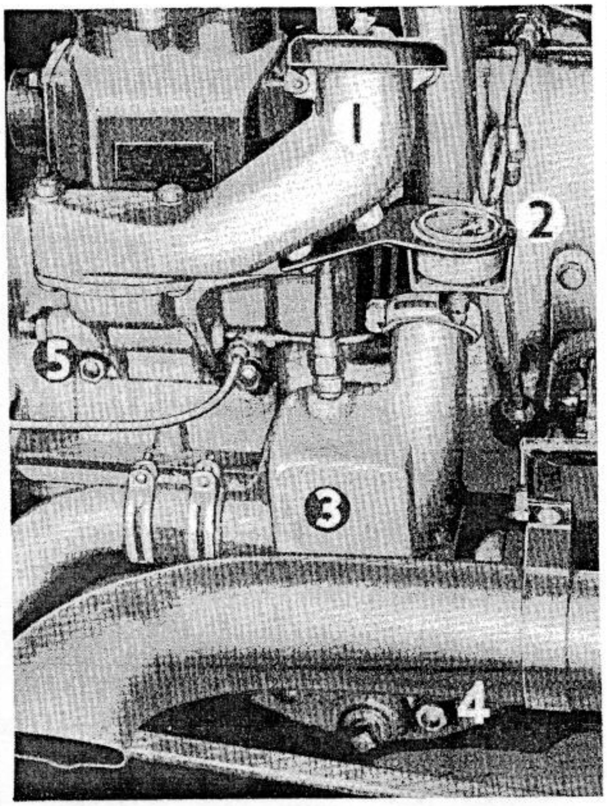
Oil pan is provided with removable plates to facilitate inspection and cleaning of oil screen. Rear cover is provided with magnetic type oil drain plug to which iron and steel particles adhere. Magnetic plug should be thoroughly cleaned at each oil change.

During cold weather, bottom cover should be removed at least every 10,000 miles and thoroughly cleaned of any sludge formation. Oil pump screen should be removed from rear cover and blown out with compressed air.

OIL PUMP

Oil pump, Fig. 23, is mounted on crankcase opposite No. 6 bearing, and driven from camshaft by helical gears. Drive gear is keyed on camshaft, and locked with set screw and thrust collar

Pump is of special dual construction, having two sets of gears enclosed in separate housings. Lower gear set circulates oil thru filter, while upper gear set forces oil directly to engine bearings. Lower pump return line empties directly into intake of upper pump. If oil supply from lower pump is inadequate, due to high viscosity when starting, additional oil is taken into upper pump through intake passage leading directly from sump.



1. Oil Filler
2. Oil Gauge
3. Oil Cooler
4. Oil Filter
5. Pressure Reg. Plug

Fig. 22 Filter, Cooler, Gauge, and Filler are Mounted as Shown

REMOVAL

Oil pump may be removed in following manner:

1. Drain crankcase.
2. Remove oil pan cover and disconnect oil lines attached to pump. After two stud nuts at pump body flange are removed, withdraw assembly by pulling it straight down.

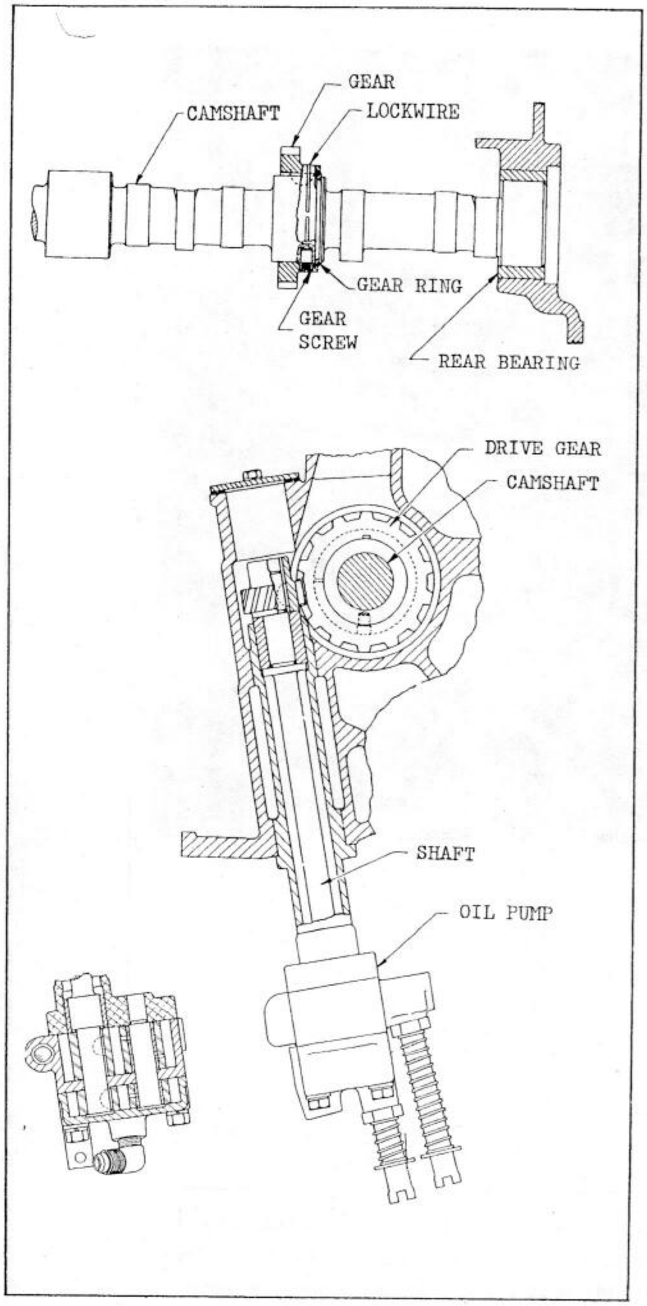


Fig. 23 Oil Pump and Drive Gears

3. After gears are removed from drive shaft, remove pins which hold upper bushing in place. Withdraw shaft, drive gear, and upper bushing.

INSPECTION

Examine condition of teeth on gears and check backlash between the gears. End clearance should also be checked by placing steel scale across face of housing and using feeler between scale and gears. Clearance may be reduced by grinding housing on flat surface with abrasive compound. End clearance and back limits may be found in "Specifications" section.

Lower drive shaft bushing is line-reamed after assembly in housing. When reamer is used, make sure that pilot is long enough to extend through upper bushing in housing. Upper bushing is reamed to size before assembly.

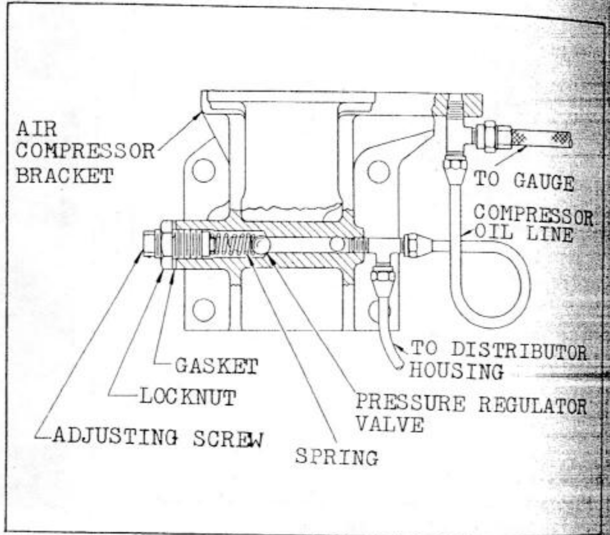


Fig. 24 Oil Pressure Regulator Valve is Located in Compressor Base

OIL PRESSURE RELIEF VALVE

Maximum pressure in engine oiling system is governed by pressure relief valve located in air compressor bracket, as shown in Figs. 22 and 24.

When pressure in system overcomes spring tension in pressure relief valve, ball is forced from seat, allowing oil to by-pass, thus preventing further increase in pressure.

OIL GAUGE

Two oil gauges are used, one mounted on instrument panel, and one mounted on oil filler neck, as shown in Fig. 22.

Gauge mounted on instrument is electrically controlled. The sender unit is mounted at right hand side of air compressor bracket with a connecting pressure line. Action of oil pressure in sender registers pounds pressure at instrument panel gauge.

Gauge mounted on oil filler, Fig. 22, is direct pressure type for purpose of checking pressure at the engine.

If oil pressure falls below 5 lbs., inspection of oiling system should be made.

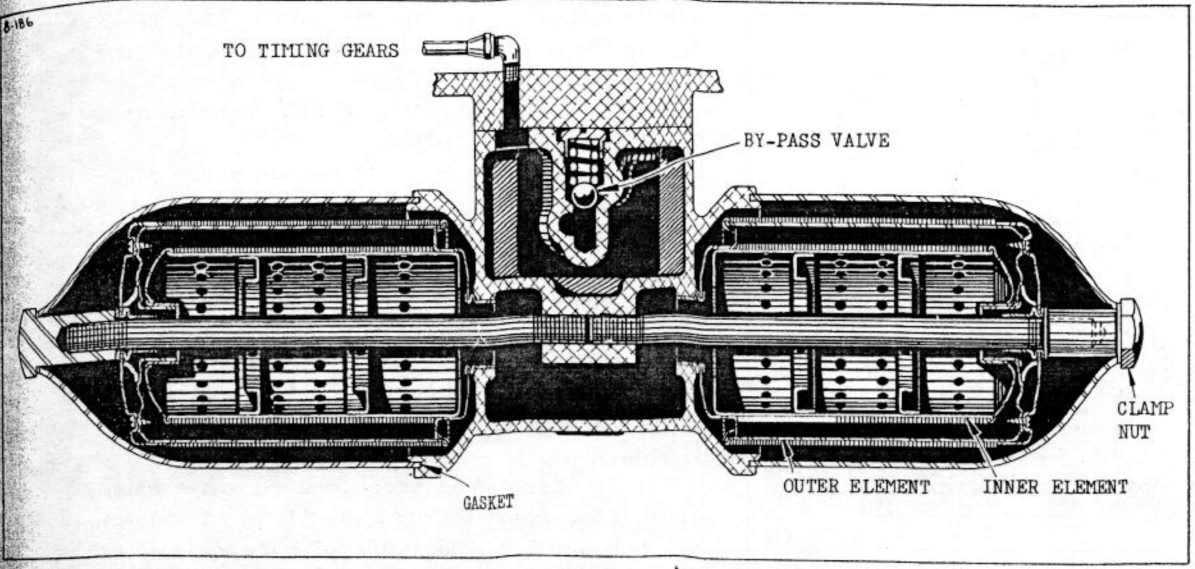


Fig. 25 Oil Filters are Mounted as Shown.

The following conditions will contribute to low oil pressure:

1. Low oil level or thin oil. Check oil.
2. Faulty gauge or connections. Tighten connections and replace gauge if necessary.
3. Loose line connection, or leaky and broken lines. Tighten or replace as required.
4. Broken or weak spring in regulator. Check spring against specifications.
5. Excessive main or connecting rod clearance.
6. Excessive clearance or backlash in oil pump gears.
7. Oil pump screen clogged.
8. Ice in oil pan or lines.

ADJUSTING OIL PRESSURE

When necessary to adjust oil pressure, loosen locknut and turn adjusting screw, Fig. 24, clockwise to increase pressure and counter-clockwise to decrease it. Tighten locknut securely after adjustment is made.

OIL FILTER

Two oil filters are used. They are mounted on common base, as illustrated in Fig. 25. Each filter comprises an inner and outer filtering element mounted as shown. Filtering elements are made of narrow ribbon stock wound on outside of metal stamping having corrugations equally spaced radially. Ribbon is provided with flat spots .003" deep at given distances. When wound on stamping, this forms openings through which oil passes. Entire surface of both elements is exposed to crankcase oil under pressure, thus providing maximum filtering area.

Filter assembly body has by-pass valve which permits uninterrupted flow of oil around filter when oil is cold and thick, or if filter elements are clogged up. Pressure relief valve, also located in body as shown, prevents excessive pressure in filter. Both valves are fixed type. Valve springs, however, should be tested against specifications given in "Spe-

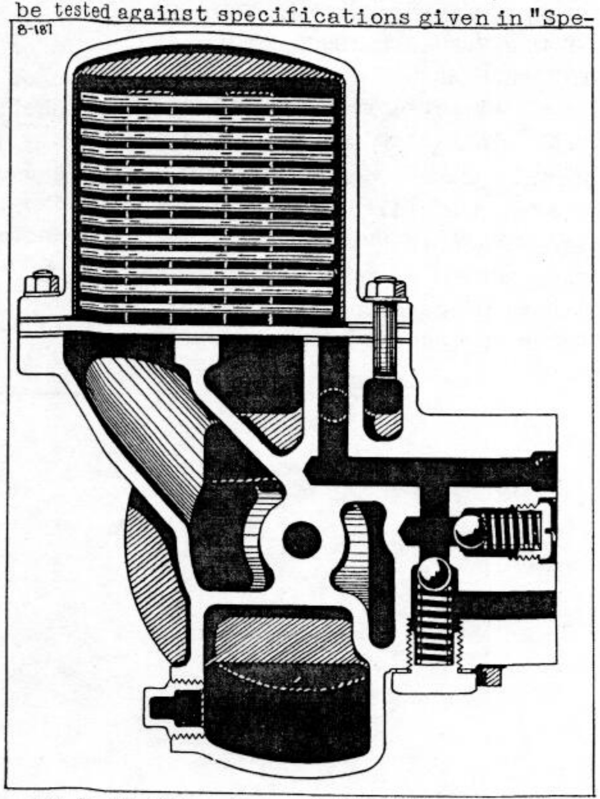


Fig. 26 Oil Filter Base and Oil Cooler Mounting.

Engine Tune-Up

Results obtained from an Engine Tune-Up are often unsatisfactory, because a "hit and miss" method was used instead of a systematic approach to the job. Too often, mechanics are inclined to guess at the cause of faulty operation, when a complete tune-up is actually in order.

The most common cause of poor performance and excessive operating costs is a combination of maladjustments among the fundamental items of Engine Tune-Up. Therefore, the only logical solution is a complete check following the cycle shown in the accompanying illustration and carrying out each step, as follows:--

1. SPARK PLUGS

(a) Check to be sure that proper make and type are being used.

(b) Clean plugs with an abrasive type spark plug cleaner.

(c) Inspect porcelain and if cracked or broken and replace with new part.

(d) Set gap to dimension recommended in "Specifications" at end of Distributor section, using a round feeler gauge. When regapping is necessary adjust side electrode only, never bend center electrode.

(e) Be sure that plug is tight when installing and that gasket is in good condition.

2. IGNITION CABLES

(a) Check ground strap - be sure that both terminals are clean and tight.

(b) Check battery to starter cable - be sure that both terminals are clean and tight.

(c) Check spark plug and other ignition cables. Terminal on each end must be tight and clean if rubber insulation shows evidence of deterioration it should be replaced.

3. DISTRIBUTOR

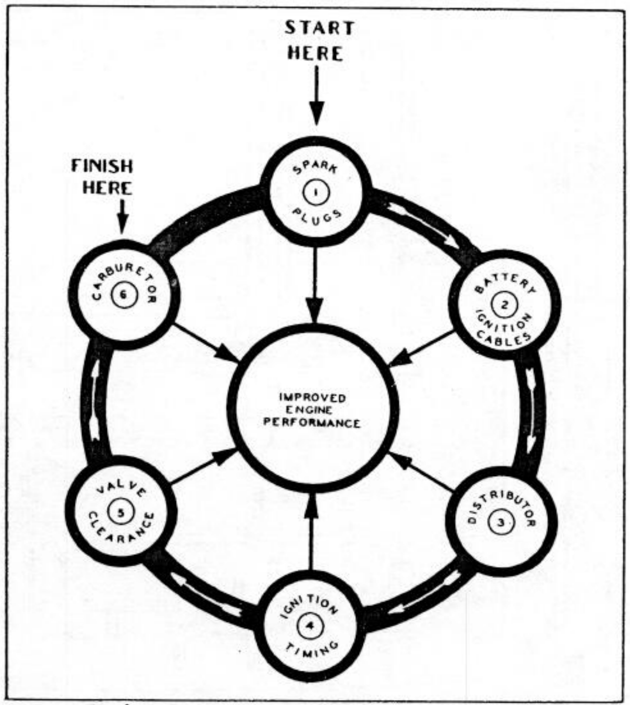
(a) Check distributor points for evidence of pitting or burning. Replace if they cannot be cleaned up with point file. Never use emery cloth to clean distributor points.

(b) Check point gap with feeler gauge. Adjust to dimension shown in "Specifications".

(c) Check distributor cap for cracks and replace if cracked or if posts are burned appreciably.

(d) Check rotor to be sure spring contacts secondary terminal, and that point is not burned from arcing.

(e) Check condenser terminals to be sure they are clean and tight. Check condenser for evidence of breaking down when hot.



Engine Tune-Up Should be in Order Shown.

4. IGNITION TIMING

(a) Check ignition timing to be sure #1 cylinder is firing according to flywheel markings. A Neon tube light or synchroscope should be used for this operation.

(b) Set manual advance or octane selector to suit quality of fuel being used.

5. VALVE CLEARANCE

(a) Check valve lash against clearance shown in "Specifications" on following pages. Engine must be thoroughly warmed up before checking.

(b) Make visual inspection of valve springs for broken coils.

6. CARBURETER

(a) Clean air cleaner as directed in "Fuel System" section.

(b) Check carbureter flange and intake manifold gasket for leaks. Manifold vacuum should be within limits shown in "Specifications" at end of "Fuel System".

(c) Check exhaust manifold heat control mechanism as directed in "Fuel System" section. Adjust to conform with seasonal temperature.

(d) Check float level as instructed in "Fuel System" section. Correct float level height is given in "Specifications".

(e) Adjust idling screw until engine runs evenly and steady with leanest possible mixture. Engine should be thoroughly warmed up before adjusting carbureter.

ENGINE

Complete power plant, including engine, clutch, transmission and accessories, is mounted as a unit, as shown in illustration, and may be removed as such as outlined below. Transmission may also be removed as a unit, independent of engine, to permit service operations on clutch or transmission.

Power plant units and accessories are accessible for service operations through rear and right hand compartment doors.

REMOVING POWER PLANT

1. Unlock right and left hand and center rear doors and transmission inspection doors.
2. Shut off starter circuit cut-out switch. This switch is located in engine compartment in extreme upper right hand corner.
3. Remove center rear door to bumper bolts. Raise center rear door and provide a suitable means of holding door fully open.
4. Remove bumper right hand pin and swing bumper outward, away from engine.
5. Unlock engine pan spring at left hand corner, remove bolts and clips at forward edge of pan, and remove pan.
6. Drain water system. Two drain cocks must be opened; one under water pump and one under forward radiator water outlet line.
7. Disconnect upper water hose, lower water hose and heater supply line.
8. Disconnect heater control supply line at water manifold.
9. Disconnect flexible air line at transmission control cylinder.
10. On gasoline engines, disconnect air compressor supply line at bulkhead and air compressor intake line at air cleaner. On Diesel engines disconnect air supply line at air compressor.
11. On gasoline engines, disconnect carbureter air intake line at carbureter air manifold. On Diesel engines, disconnect blower hose at blower housing. (Cover air inlet opening to prevent dirt or other foreign material from getting into blower).
12. Disconnect fuel lines at right hand side of bulkhead.
13. Remove engine wiring plug - at right hand upper end of engine compartment.
14. Disconnect engine ground strap - between engine and frame on bulkhead side.
15. Disconnect starter cable.
16. Disconnect throttle control at engine bellcrank.
17. Disconnect clutch, emergency brake, and transmission controls at transmission.
18. Disconnect speedometer cable - at transmission.
19. Unloosen propeller shaft slip joint seal retainer.
20. Place special dolly under engine and raise engine sufficiently to relieve pressure on mounting bolts.
21. Disconnect engine stay rod eye - at stay bar bracket on engine.
22. Remove transmission to insulator bolts - at right hand corner strut.
23. Remove transmission to engine support bolts at engine right hand support.
24. Remove transmission insulator to frame bolt nut - at bulkhead side of transmission.
25. Remove engine to generator connector arm bolt at engine.
26. Remove generator drive belts.
27. Unhook transmission dust pan and drop pan.
28. Remove right hand engine support member to right hand strut bolt and allow support member to swing down.
29. Remove right hand strut to body frame bolt and remove strut.
30. Pull engine through rear opening.

TRANSMISSION REMOVAL

Transmission may be removed from chassis without disturbing engine - as follows:

1. Open transmission door on right hand rear side of coach. Also open center and right hand rear doors.
2. Remove muffler shields and support brackets.
3. Disconnect transmission, clutch and brake controls.
4. Disconnect muffler brace bar at transmission.
5. Unfasten and lower engine pan and transmission pan.
6. Disconnect Duo-Speed governor control cable at transmission shift lever. (Must be readjusted at governor after reinstalling transmission).
7. Disconnect transmission control cylinder air line at transmission.
8. Disconnect speedometer at transmission.
9. Remove air cleaner to engine pipe and air cleaner intake pipe.
10. Loosen slip joint dust cap on propeller shaft.
11. Place support under engine and transmission dolly under transmission.

SPECIFICATIONS

"A"----------------------------.031"-.036"
"B"----------------------------.025"-.030"
"C"----------------------------.023"-.028"
"D"----------------------------.039"-.050"
"E"--------------------------.0065"-
"F"--------------------------.0045"-

Fit Pistons With 1/4", thick shim,
to lbs. pull at 70° Room
Temperature.

Oversizes Available-----.010"-.020"-.030"-
.040"-.050"-.060"-.065"

PISTON PINS

Type-----------------------------Floating
Length----------------------4.473"-4.463"
Diameter (Standard)-----1.37450"-1.37425"
Oversize Diameters
.0025"-----------------1.37700"-1.37675"
.005"------------------1.37950"-1.37925"
.010"------------------1.38450"-1.38425"
Fit in Connecting Rod Bushing-----.00025"-
.0010"
Ream Bushing in Connecting Rod----1.37475"
-1.37500"
Ream Piston Boss----.00025"-.0010" Smaller
Than Pin Diameter

PISTON RINGS

Number of Compression Rings-------------3
Number of Oil Control Rings-------------2
Compression Rings
Type of Joint------------------------Butt
Location------------------Top 3 Grooves
Width------------------------.193" Max.
Thickness-----------------.1240"-.1230"
Clearance in Groove---------.001"-.003"
Gap------------------------.020"-.025"

UPPER OIL RING

Location-------------------------Above Pin
Type of Joint-------------------------Butt
Width----------------------.1865"-.1860"
Thickness--------------------.1855"-.1860"
Clearance in Groove----------.001"-.0035"
Gap--------------------------.012"-.017"

LOWER OIL RING

Location-----------------------Below Pin
Type of Joint-----------------------Butt
Width---------------------.1855"-.1860"
Thickness------------------.1855"-.1860"
Clearance in Groove----------.0015"-.003"
Gap---------------------------.012"-.017"
Oversize Rings Available------.010"-.020"
.030"-.040"-.050"-.060"

CAMSHAFT

Marked With Letter G - See Fig. 12.
Clearance Between Bearing and Shaft
Front----------------------.0025"-.0035"
Others---------------------.0025"-.0040"
Bearing Size (Ream After Installation)
Front----------------------1.625"-1.626"
Second-------------------2.3055"-2.3065"
Center-------------------2.3005"-2.3015"
Fourth-------------------2.2955"-2.2965"
Rear---------------------2.2855"-2.2865"

TIMING GEARS

Backlash-----------------------.002"-.004"

TIMING

Intake Opens-----------------8° B.U.D.C.
Intake Closes---------------52° A.L.D.C.
Exhaust Opens---------------55° B.L.D.C.
Exhaust Closes--------------20° A.U.D.C.
Intake Valve Total------------------240°
Exhaust Valve Total-----------------255°

EXHAUST VALVES

Length----------------------------7.601"
Type----------------------Sodium Filled
Face Angle---------------------------30°
Diameter of Stem--------------.559"-.560"
Diameter of Head------------1.960"-1.954"
Lash--------------------------------Zero

INTAKE VALVE

Length----------------------------7.458"
Type---------------------------One Piece
Width of Face----------------.364"-.384"
Face Angle---------------------------30°
Diameter of Stem------------.4350"-.4340"
Diameter of Head------------2.440"-2.434"
Lash--------------------------------Zero

VALVE STEM GUIDES

Exhaust----------
Ream After Assembly---------.5630"-.5635"
Stem and Guide Clearance-----.003"-.0045"
INTAKE
Broach after Assembly-------.4370"-.4380"
Stem and Guide Clearance------.002"-.004"

Fuel System

Instructions and Illustrations in This Group Apply to Following Subjects:

Carbureter
Electric Choke
Fuel Pump
Air Cleaner
Governor
Tanks and Lines
Crankcase Ventilation
Manifolds and Muffler
Accelerator and Control Rods

Instructions Applying to Related Parts of Fuel System Will be Found in Following Groups:

Name	Group	Name	Group
Wiring Diagram	7W-0001	Diesel Engine	Diesel Manual
Engine	8-7101	Body	3-1701

Instructions and illustrations shown in this group apply only to fuel system as used with gasoline engine. Fuel system instructions applicable to Diesel engine are listed in the Diesel Operating Manual.

As accelerator control rods are closely related to brake and clutch pedal control entire linkage is illustrated and discussed in this group.

CARBURETER

Carbureter used on this vehicle is Stromberg, Model DDR5, duplex down draft type especially designed for heavy duty work. Principle of operation is plain tube using air-bled jet to maintain proper mixture ratio throughout entire range of throttle opening and engine speed. Fig. 1 illustrates various sections of carbureter.

This model is comparable to two carbureters built into one unit. It comprises venturi tube, main metering jet, idle system with adjustable needles, throttle valve, and pump discharge nozzle for each barrel, all of which are supplied fuel by one float chamber. Only one air intake is used.

Accelerating pump, which is connected directly to throttle, provides rapid acceleration and flexibility at all speeds. It delivers charge immediately as throttle is opened, and meters this charge over definite period of time.

Economizer, which is controlled by manifold vacuum in accordance with road speed and load, provides economical mixture at part throttle positions for average driving, and automatically shifts to richer mixture when full power of engine is required.

Carbureter is completely sealed, as all air taken in for float chamber venting and bleeder purposes must pass through air cleaners.

All jets are fixed type, with exception of idling jet, and are calibrated at factory to supply correct mixture for normal operating conditions. These jets should not be changed without special instructions from factory. Jet sizes are stamped on outer face of jets and numbers represent size of orifice in thousandths of an inch. Refer to "Specifications" section for calibration specifications.

OPERATION

INTERMEDIATE SPEED (MAIN METERING SYSTEM)

Air entering carbureter through air entrance at top produces suction on main discharge jet (2) or idle discharge hole (shown at 37) depending upon amount of throttle opening.

Main metering jets (9) are of fixed type, and control flow of fuel during intermediate or part throttle position. From metering jet fuel passes into main discharge jet (2), where it is mixed with air from high speed bleeder (1). Mixture then flows through carbureter barrel in intake manifold.

MAXIMUM POWER OR HIGH SPEED

For maximum power or high speed running, richer mixture is required. Operation of economizer by-pass jet is controlled by manifold vacuum with channel (13) being open to manifold below throttle valves.

On closed throttle, with high manifold vacuum, piston (14) is raised up, and as throttle is opened, manifold vacuum decreases to point where piston spring (15) has more force. In that manner, assembly is moved downward, opening economizer by-pass jet (16), which also allows fuel to flow through economizer valve in addition to that supplied by main metering jet. Metering orifice of by-pass jet (16) is located in cup at bottom of chamber.

ACCELERATION

For smooth, rapid acceleration and flexibility, it is necessary to supply momentarily extra amount of fuel when throttle is opened. Accelerating pump is directly connected to throttle by linkage (22) and fulcrum arm (23). As throttle is opened, pump sleeve (17) is moved downward, compressing fuel in its chamber and forcing piston (18) off its seat. Fuel then passes through valve (20) and is discharged through nozzles (21) into each barrel.

When throttle is held in a steady position, spring (19) returns piston (18) to its seat, thus cutting off accelerating fuel supply.

IDLING

Fuel for idling speeds is taken through idle tube (29). Air is fed through bleeder hole (31) through needle valve adjustment and mixed with fuel which passes down channel (30) to be discharged through idle holes (37).

On "curb" idle or closed throttle position, fuel is drawn only from lower idle discharge hole, and as throttle is opened for increased engine speed, upper idle discharge hole is exposed to suction, and fuel is taken from it also.

MAINTENANCE AND ADJUSTMENTS

IDLING ADJUSTMENT

Two idling adjustment screws (27) are provided. Make adjustments in following manner:

1. Make sure that valves are seating properly and that all other engine units are in proper adjustment, such as distributor points, spark plug gaps, etc., before attempting to adjust idling mixture.
2. Warm up engine thoroughly and slow down to desired idling speed (throttle stop screw - 41).
3. Idle needle valves (27) control air, and turning "in" gives richer mixture "out" leaner mixture. Adjust each barrel separately.
4. Turn one idle adjustment out slowly until engine begins to "roll". Finally very, very slowly turn adjustment in again just enough so that engine runs smoothly for this throttle opening. Other idling adjustment may be turned in so far that "roll" cannot be overcome without changing it also.
5. Follow same procedure with other idling adjustment screw. Adjustment should be such that any change in either idling screw will affect engine operation.
6. It may be necessary after making the adjustment, to increase or decrease idling speed. Adjust throttle stop screw (41) accordingly.
7. If, after making preceding adjustment, idling is not satisfactory, remove plug (36) and make certain that idle discharge holes are open.

SYNCHRONIZING THROTTLE VALVES

Since all fuel mixture entering cylinders is taken through two throttles, it is necessary that these throttles be properly synchronized to open simultaneously. If throttles are not synchronized, some cylinders would receive more mixture than others, with rough engine operation as the result.

Synchronize throttles in following manner:

1. Carbureter must be removed from engine to synchronize throttles.
2. Back out stop screw until both throttle valves are completely closed.
3. Make certain that each barrel is entirely closed by throttle fly. Loosen shaft screw and shift fly if necessary.
4. Place a strip of tissue paper 3/16" wide between throttle valve and body of both barrels.
5. Draw the strips of paper from both barrels. A slight resistance or "drag" should be necessary to withdraw paper strips. The same drag should be evident on both barrels.
6. If drag is not the same on both barrels, adjust the stop screw (41) to obtain proper drag on forward barrel. Then remove cotter pin (33) and adjust screw (34) on synchronizing lever (35) to obtain same drag on rear barrel.

tight. (See Wiring Diagram)

3. Nuts holding choke to air intake manifold must be tight.

Adjust position of electric choke lever in following manner:

1. Remove choke cover.
2. Place .015" shim on field pole, as shown in Fig. 2. Pull lever toward carbureter as far as possible.
3. Loosen clamp screw on carbureter choke lever until lever turns freely on shaft.
4. With carbureter choke valve completely closed, adjust lever so that rods from lever to electric choke do not bind.
5. Remove shim and install cover.
6. Check operation of choke. With ignition and choke button on, choke valve should close completely.

Donot oil electric choke under any circumstances. If choke coil burns out through excessive use or heat, that part may be readily replaced with a new choke coil assembly.

FUEL PUMPS

Two fuel pumps of the type illustrated in Fig. 3, are mounted on bulkhead side of engine. Each pump is operated independently from eccentric on camshaft through linkage.

Both fuel pumps operate continuously, however, either pump can be made inoperative by turning shut-off cocks at pump, or by turning four-way valve mounted as shown in Fig. 3.

Internally, pumps are same in design, and are interchangeable "front" and "rear".

Rotation of camshaft eccentric actuates rocker arm which pulls link and diaphragm downward against spring pressure, thereby creating vacuum in pump chamber. This action constitutes suction stroke of pump.

On suction stroke, fuel from supply tank enters pump through inlet, passing into sediment chamber. From sediment chamber, fuel is drawn through strainer and inlet valve into pump chamber.

On return stroke of rocker arm, spring pressure pushes diaphragm upward, forcing fuel out of pump chamber through outlet valve and to carbureter through pump outlet.

When fuel in carbureter reaches proper level, float needle valve closes, preventing any more fuel from entering carbureter. Therefore, sufficient pressure is built up in pump to hold diaphragm down against spring pressure so that it remains inoperative until carbureter requires more fuel.

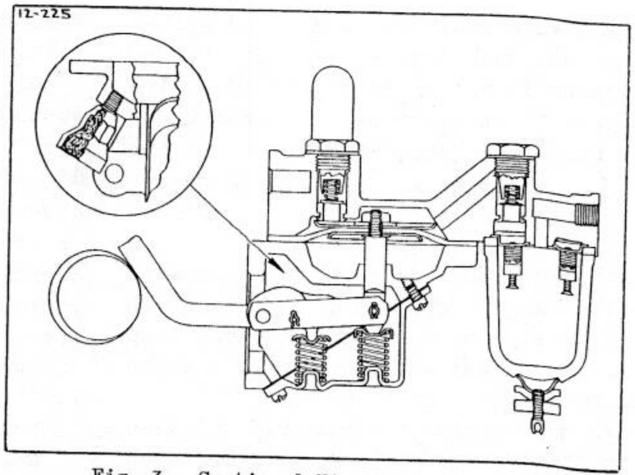


Fig. 3. Sectional View of Fuel Pump.

Spring shown below rocker arm pivot is simply for the purpose of holding rocker arm in contact with eccentric regardless of position of diaphragm.

CLEANING SEDIMENT CHAMBER

Sediment chamber should be cleaned periodically. This chamber can be cleaned after loosening knurled nut and sliding bowl out sideways.

Following inspections should be made:

1. Inspect pipe connections at pump, tank, and carbureter. Tighten if necessary.
2. Make sure that carbureter float is set correctly, and that float needle valve seats properly.
3. Remove glass sediment bowl and clean screen. When bowl is reinstalled, make sure that cork gasket is in good condition and lies flat on its seat. Tighten sediment bowl retaining nut securely.
4. Remove suction valve plug and air-dome. Examine the valves and gaskets. Clean out the valve seats and renew the valves if warped.

ANALYZING PUMP OPERATION

After preceding inspections are made, operation of pump should be tested with an A.C. analyzer.

In using the analyzer, bear in mind that two separate and distinct tests are available and that the two tests bear no relation to each other. The tests provided, if prop-

(e) Place upper diaphragm washer over threaded end of pull rod with dished or cupped edge AWAY FROM DIAPHRAGM.

(f) Install hexagon shaped washer, lock washer, and nut on pull rod. When tightening nut, do not twist diaphragm cloth.

3. Cover Assembly

THE POSITION OF DIAPHRAGM WHEN COVER IS INSTALLED, IS THE MOST IMPORTANT ITEM TO OBSERVE. DIAPHRAGM MUST BE IN PROPER POSITION WHEN TOP COVER SCREWS ARE TIGHTENED OR PUMP WILL NOT FUNCTION PROPERLY (CREATES OVER-PRESSURE).

(a) Install cover in proper relation with body. Determine this by marks placed on cover and body before pump was disassembled.

(b) Insert screws from top through upper cover, diaphragm and body.

(c) Push up on diaphragm pull rod so that diaphragm is in its highest position, and while held in this position, tighten the cover screws alternately.

4. Valve Assembly

(a) Blow out valve chamber with compressed air. Examine valve seat for small particles of dirt which might prevent valve from seating properly.

(b) Install new fibre valve in proper position in valve chamber. Make certain that valve lies flat against valve seat and is not standing on edge.

(c) Insert valve spring on top of valve.

(d) Place fibre gasket on valve plug, and then place stem of valve plug into coil spring, and tighten plug securely. Stem of valve plug must fit snugly into spring.

(e) Assemble outlet valve and air-dome in same manner.

5. Bottom Cover Assembly

(a) Invert body and place rocker arm and diaphragm spring caps in position.

(b) Install new gasket between pump body and lower cover.

(c) Locate springs for diaphragm and rocker arm in their proper positions on bosses in lower cover. The diaphragm spring is slightly longer than rod or arm spring. Carefully assemble lower cover to pump body so that springs and caps are in their proper position. Tighten the three machine screws securely.

6. Final Assembly

(a) Assemble upper screen in pump body. Fit it securely around gasoline inlet and edge of casting.

(b) Install strainer gasket next to upper screen, then complete the assembly of glass bowl, lower screen, etc.

7. Testing

(a) After final assembly, install on engine and test with analyzer as previously explained.

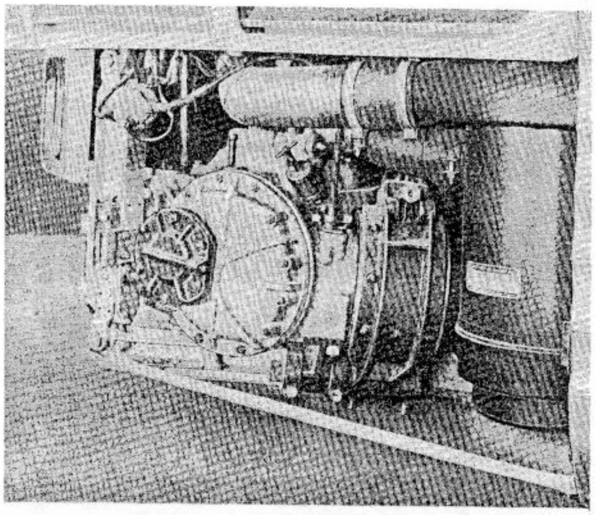


Fig. 4. Air Cleaner is Mounted as Shown.

AIR CLEANER

Air cleaner is mounted in engine compartment as illustrated in Fig. 4. Cleaner is connected to air intake duct located at right rear corner of coach. Air intake opening to duct is at upper corner and is covered with a metal louvre. See Fig. 5. Air is directed to carbureter from air cleaner through a large tube.

Air cleaner is accessible for service by opening right transmission inspection door and dropping lower right compartment dust pan.

Tests on these cleaners have proven that practically all dirt entering units is filtered out of the air, provided units cleaners are cleaned and maintained properly at regular intervals.

When consideration is given to the volume of air taken in by these cleaners and the amount of dirt present in average "road" air, the important task imposed on coach air cleaners can well be realized.

A conservative estimate of the amount of

2. Push control cable into conduit as far as possible and then pull back 1/8".
3. Slip clevis end of cable over pin in shift lever and then clamp cable conduit to bracket.

DUO-SPEED GOVERNOR CONTROL (DIESEL ENGINES)

The functional purpose of the Duo-Speed governor control on Diesel Engines is essentially the same as described above for gasoline engines. Its adjustment; however, differs and complete instructions for this service is contained in current issue of "Diesel Operating Manual".

OVERSPEED WARNING SIGNAL

The purpose of the overspeed warning signal (on vehicles so equipped) is to notify driver when engine speed exceeds specified R.P.M. Buzzer in driver's compartment is operated by switch in governor housing. Screw on side of governor housing may be adjusted so that warning signal is given at R.P.M.'s noted in "Specifications" section.

CRANKCASE VENTILATION

Air is taken into crankcase through two small air cleaners at clutch end of engine, as shown in Fig. 7, vapors are withdrawn from crankcase through ventilator valve mounted on valve covers. Vapors then pass directly into intake manifold vapor stream. See Fig. 5.

Crankcase air cleaners should be cleaned and refilled with SAE 50 oil at regular intervals. When cleaners are reinstalled, make certain that mounting set screw on each cleaner is inserted in hole in flange of cleaner. If tubular flange on cleaner is bent, air which has not been cleaned will enter crankcase.

FUEL LINES AND LINKS

Two main fuel system tanks are used on these vehicles. Fig. 8. The auxiliary tank is mounted in rear of rear axle while the main tank is mounted in front of rear axle. Each tank is equipped with separate filler neck extending to side of body as indicated in "Body" group of this book.

Both tanks are interconnected, Fig. 8, with selector valve by which supply of fuel may be used from either or both tanks. The selector valve is mounted at right rear of body (behind right rear wheel) and is controlled from outside of coach with a socket key. Location of selector valve control plate is indicated in "Body" group of this book.

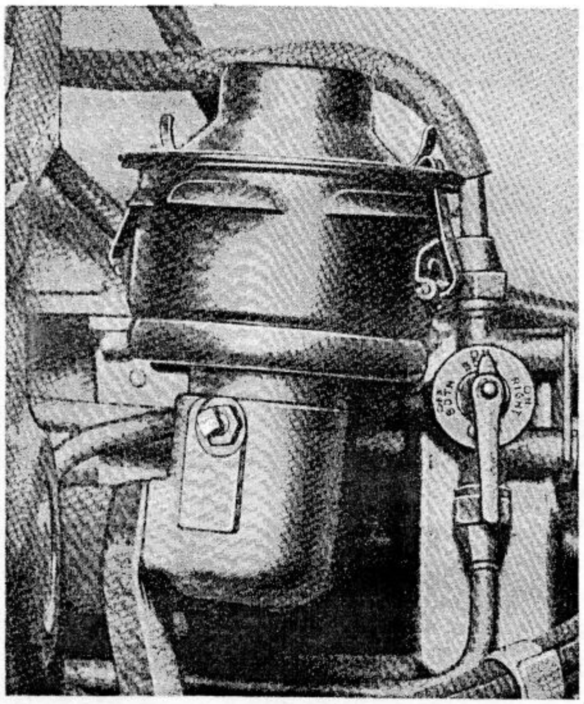


Fig. 7 Crankcase Breather Cleaners and Fuel Pump Valve are Mounted as Shown

LINES

Tank exhaust and return lines to carbureter are special copper tubing or flexible tubing and are protected where necessary with loom. Line connections should be checked for leaks at periodic intervals. Tank mountings should be regularly checked and tightened if necessary.

EXHAUST MANIFOLD AND MUFFLER

Mufflers, exhaust pipe, and tail pipe are attached directly to power plant and may be withdrawn with engine without disconnecting.

Exhaust manifold assembly is of special heat resisting material and comprises three sections mounted as shown. Cylindrical polots which fit in inner diameters of manifold ports, align ports with those in cylinder head. Special gaskets are placed between

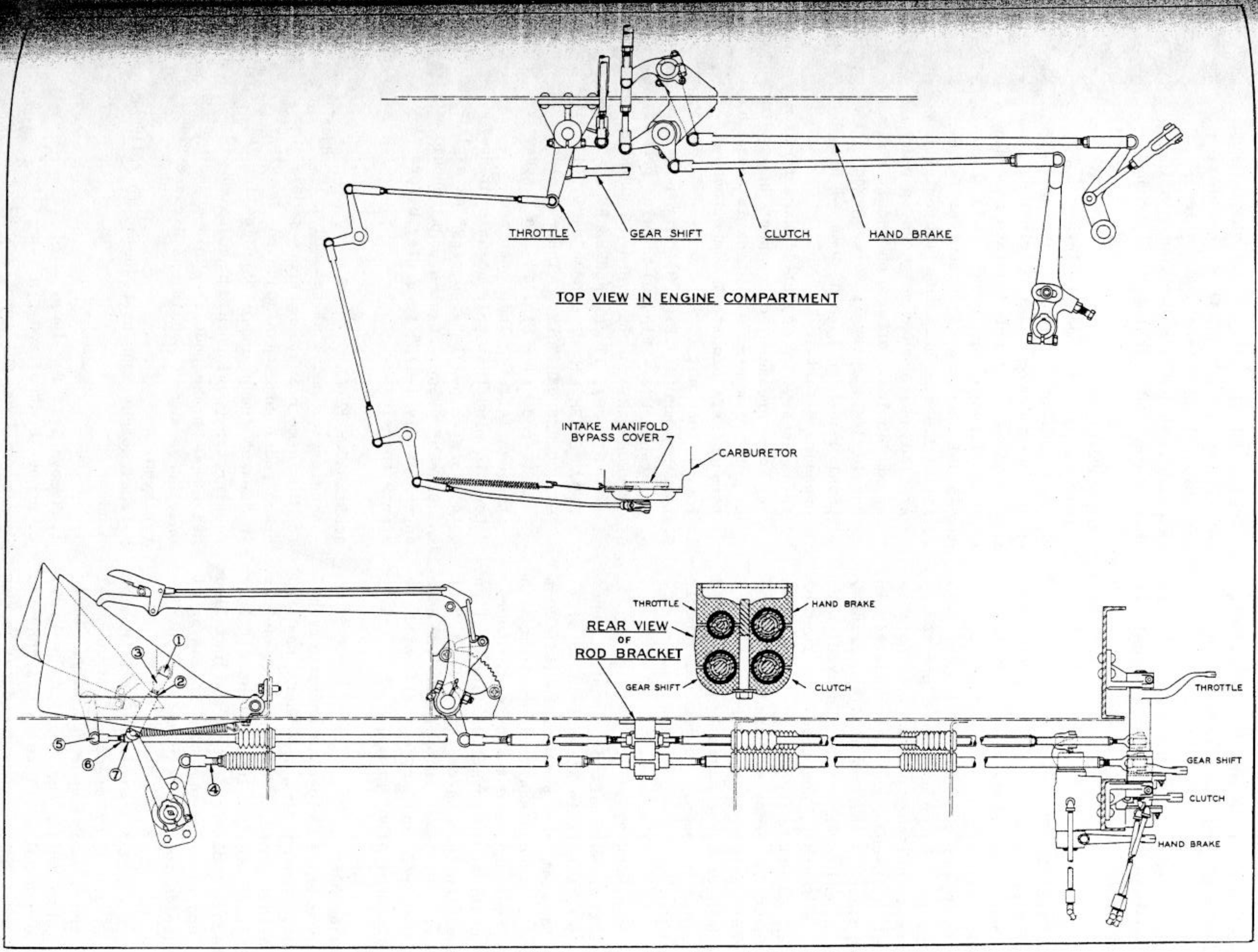


Fig. 9 Control Rod Linkage (See Also Transmission Group).

FUEL SYSTEM

INTERMEDIATE CONTROL

Hand brake, clutch, gear shift and accelerator operation is controlled by four rods extending throughout the length of coach from driver's compartment to bulkhead in engine compartment at rear. Control rods are housed in air duct compartment at left of coach and are mounted on five bearing assemblies of the ball sleeve type as illustrated in Fig. 9.

Bearings are provided with washer and retainer at both ends. Washers are thoroughly saturated with oil when assembled.

Front bearing group is accessible by first removing lower pan under air conditioning blower, then removing left hand blower motor and housing assembly and left hand air deflector plate. Bearings can then be reached through vertical hand hole.

Front intermediate bearings are accessible through right front baggage compartment as follows:

a. Pull air conditioning panel out.
b. Remove air conditioning air filter. This will expose bearings toward rear of opening.

Center intermediate control rod bearings are accessible by removing baggage compartment top panel.

Rear intermediate bearings are accessible by removing rear baggage compartment top panel.

Rear control rod bearings are accessible through inspection hole immediately behind front fuel tank, after removing inspecgion hole cover.

REAR CONTROL

Cross shaft, bell crank, and levers at engine bulkhead are illustrated in Fig. 9. Linkage to various units are adjusted at factory and do not require service adjustments unless linkage parts are disassembled for repair. When linkage parts are adjusted, make certain that all clevis pins do not bind after connections are completed.

LUBRICATION POINTS

Following is a description of operations necessary to lubricate fuel system. Refer to Lubrication Chart (Group 13) for lubricant specifications and periods.

1. Carbureter (Gasoline Engine) - one oiler - accessible through engine compartment doors. Use oil can.
2. Air cleaner - Clean and refill to "Oil Level" marked on side of cleaner - accessible through transmission inspection door.
3. Accelerator pedal hinge pin and pedal linkage - accessible through fog lamp opening. Spray with spray gun.
4. Accelerator, clutch, hand brake and transmission gear shift control rod bearings - packed at assembly. Refer to control rod section of "Fuel" group for accessibility.
5. Control rod bell cranks - Three fittings with grease tubes - located at engine bulkhead. Accessible from underneath vehicle. One fitting for accelerator control.
6. Accelerator linkage - accessible through engine compartment doors. Spray with spray gun.
7. For further information on 'Diesel Engines" refer to GMC Diesel Operating Manual.

Lubrication

Read This Group Before Referring to Lubrication Charts

The application of the right lubricant in the right place and at the right time will greatly reduce the actual cost of transportation delivered by your vehicle.

Therefore, realizing that successful and profitable operation depends to a great extent upon proper lubrication, it is essential first, that the right lubricants be selected; secondly that the lubricant be applied at regular intervals, and thirdly, that the lubricant be applied at the right place.

THE RIGHT LUBRICANT

The lubricants chosen for use on these vehicles should meet the specifications given in the following paragraphs.

Actual experience has shown that maintenance costs increase whenever inferior grade lubricants are used. Purchase only those of known reputation.

Specifications shown in the following paragraphs are general specifications as to body and ingredients. No effort has been made to recommend or describe any particular brand of lubricant. High grade lubricants meeting in every way these specifications are easily obtainable from any reputable oil company. High quality, well refined oils and properly compounded lubricants are essential.

THE RIGHT TIME

Intervals at which various points on the chassis should receive attention are indicated in chart shown on following pages. Intervals are based upon actual experience and tests, as well as careful consideration of design and purpose of parts to be lubricated.

THE RIGHT PLACE

Lubrication fittings or accessible lubrication points have been incorporated on all mechanical units of this vehicle. It is necessary that lubricant be applied at all such points specified.

ENGINE OILS

GASOLINE ENGINES

Oil used in gasoline engine should be a well refined 100% petroleum oil of correct viscosity atmospheric temperature as shown in chart next page.

DIESEL ENGINES

SELECTION

It is safest to deal only with a reliable supplier of lubricants, and to purchase only high-grade oil which is recommended by that supplier to use in GMC Diesel Engines. SAE 30 is recommended for normal weather operation, at temperatures above 32° F. 20W is recommended where cold-starting is a problem, at atmospheric temperatures from 0° F. to 70° F. 20W is not recommended for summer operation.

Aside from the general requirements of high quality and suitability for the engine, the oil you use should:

1. Be highly resistant to formation of sludge, varnish or any insoluble substance during operation; and
2. Be and remain, during use, non-corrosive to the copper-lead bearings and to all other metals in the engine.

CHANGING LUBRICATING OIL

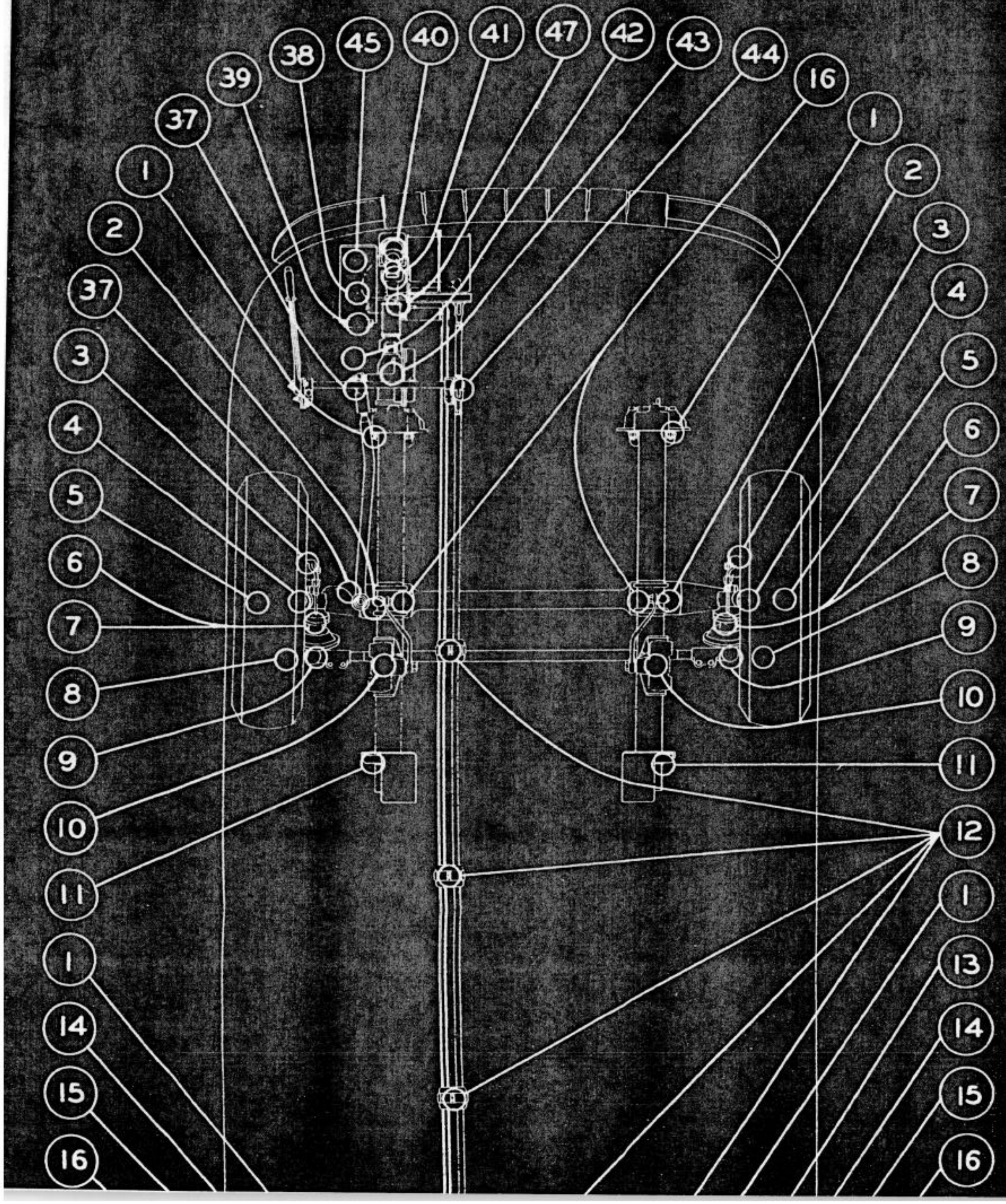
The frequency with which crankcase oil must be changed depends upon the type and quality of oil used, the severity of and the type of operation, and the condition of the engine. It is therefore impossible to make a general recommendation concerning mileage intervals between oil changes. The oil should be changed often enough to keep it non-abrasive and non-corrosive. Oil changing is closely related to filter element cleaning and changing, the frequency of which also depends upon the conditions of operation mentioned above.

Laboratory tests of oil drained from the engine, conducted by the oil supplier or by another suitable laboratory, may be helpful in determining the greatest advisable intervals between oil and filter element changes for your operation.

If the composition of the oil used is at any time modified, or if a change is made from one brand of oil to another, or if additions are made to the oil, the engine should first be thoroughly cleaned and should thereafter be examined daily, for several days, so that any excessive sludge or carbon which may form will be quickly detected. Of course oil level should always be kept to "Full" mark on oil dip stick.

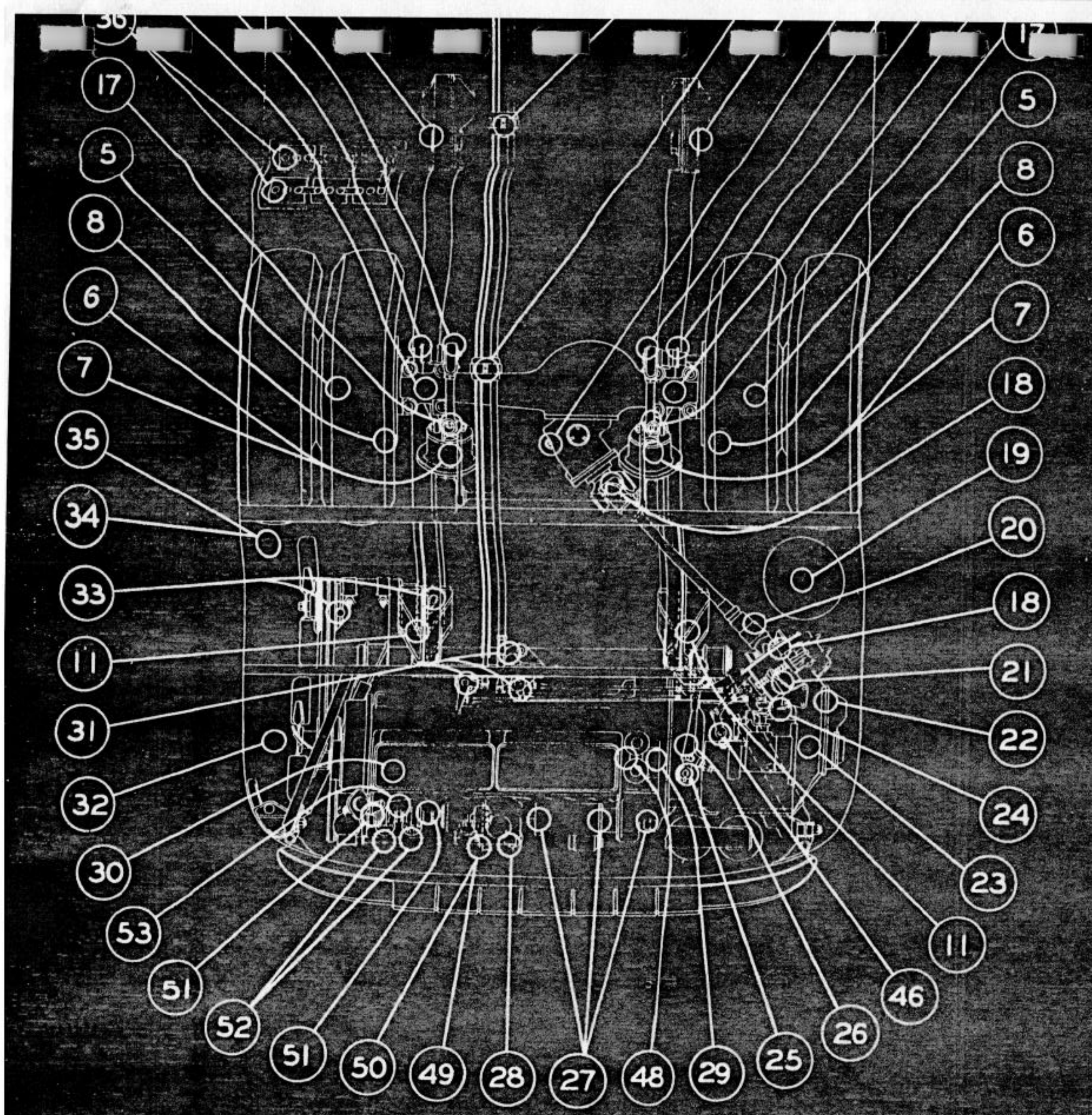
GMC FACTORY ENGINEERED LUBRICATION SERVICE

THIS PAGE SHOWS WHERE AND TELLS HOW OFTEN EACH ITEM SHOULD BE LUBRICATED



ITEMS TO BE LUBRICATED

DESCRIPTION	LUBRICATION PERIOD (MILES)	CORRECT LUBRICANT
1. Front and Rear Spring Eye	1000	C
2. Front Shock Absorber Link	1000	C
3. Front Brake Camshaft	1000	S2
3. Front Brake Slack Adjusters	1000	C
4. Steering Knuckle King Pin	1000	C
5. Front and Rear Wheel Bearings	10,000	S2
6. Front and Rear Air Chamber Clevis	1000	E
7. Front and Rear Air Chamber Boot	As Req'd	S8
8. Front and Rear Brake Shoe Anchor Pin	1000	S2
9. Tie Rod Ends	1000	C
10.Shock Absorbers	As Req'd	Spec.
11.Front and Rear Spring Shackles	1000	C
12.Control Rod Bearings	At Assy.	E
13.Differential	As Req'd	GS
14.Rear Brake Slack Adjuster	1000	C
15.Rear Brake Camshaft	1000	S2
16.Front and Rear Spring Center Bolt	1000	C
17.Sway Bar Link	1000	C
18.Prop.Shaft Universal Joints	1000	S1
19.Air Cleaner	As Req'd	E
20.Prop.Shaft Slip Joint	1000	C
21.Hand Brake Anchor	1000	C
22.Speedometer Adapter	1000	G
23.Transmission	As Req'd	ES
23.Transmission Air Shaft Cyl.	At Assy.	C
24.Clutch Release Bearing	1000	S2
25.Clutch Cross Shaft	1000	S2
26.Clutch Shaft Splines	At Assy.	S5
27.Starting Motor	1000	E
28.Engine	Daily	E
29.Clutch Pilot Bearing	5000	S2
30.Shutter Air Filter	As Req'd	E
31.Control Bell Cranks	1000	C
32.Shutter Thermostat	5000	S10



33.Generator	1000	S2
34.Shutter Air Cylinders	5000	S11
35.Shutter Linkage	5000	E
36.Battery Terminals	As Req'd	S3
37.Drag link Ends	1000	C
38.Steering Gear Bevel Gear Housing	1000	ES
39.Clutch Pedal Hinge Pin	As Req'd	E
40.Steering Column Top Bearing	At Assy.	S2
41.Steering Shaft Slip Joint	1000	C
41.Steering Shaft Universal Jts.	At Assy.	S1
42.Gear Shift Cross Shaft	1000	C
43.Steering Gear Worm Housing	1000	ES
44.Hand Brake Cross Shaft Brg.	At Assy.	C
45.Clutch Pedal Cross Shaft	1000	C
46.Hand Brake Idler Shaft Bell Crank	1000	C
47.Brake Application Valve	1000	E
*48.Crankcase Breathers	As Req'd	E
*49.Throttle and Choke Bearings	At Assy.	S1
*50.Carbureter Accelerator Pump Rod	1000	E
*51.Air Compressor Drive Univ.Jt.	1000	S1
*52.Distributors	1000	E-S3
*53.Air Compressor Drive Slip Jt.	1000	C
†54.Engine Fan Bearings	1000	S2

† Applies on Diesel Equipped Vehicles only.
* Applies on Gasoline Equipped Vehicles only.
All Other Points Apply on Both Types of Vehicles.

Note –

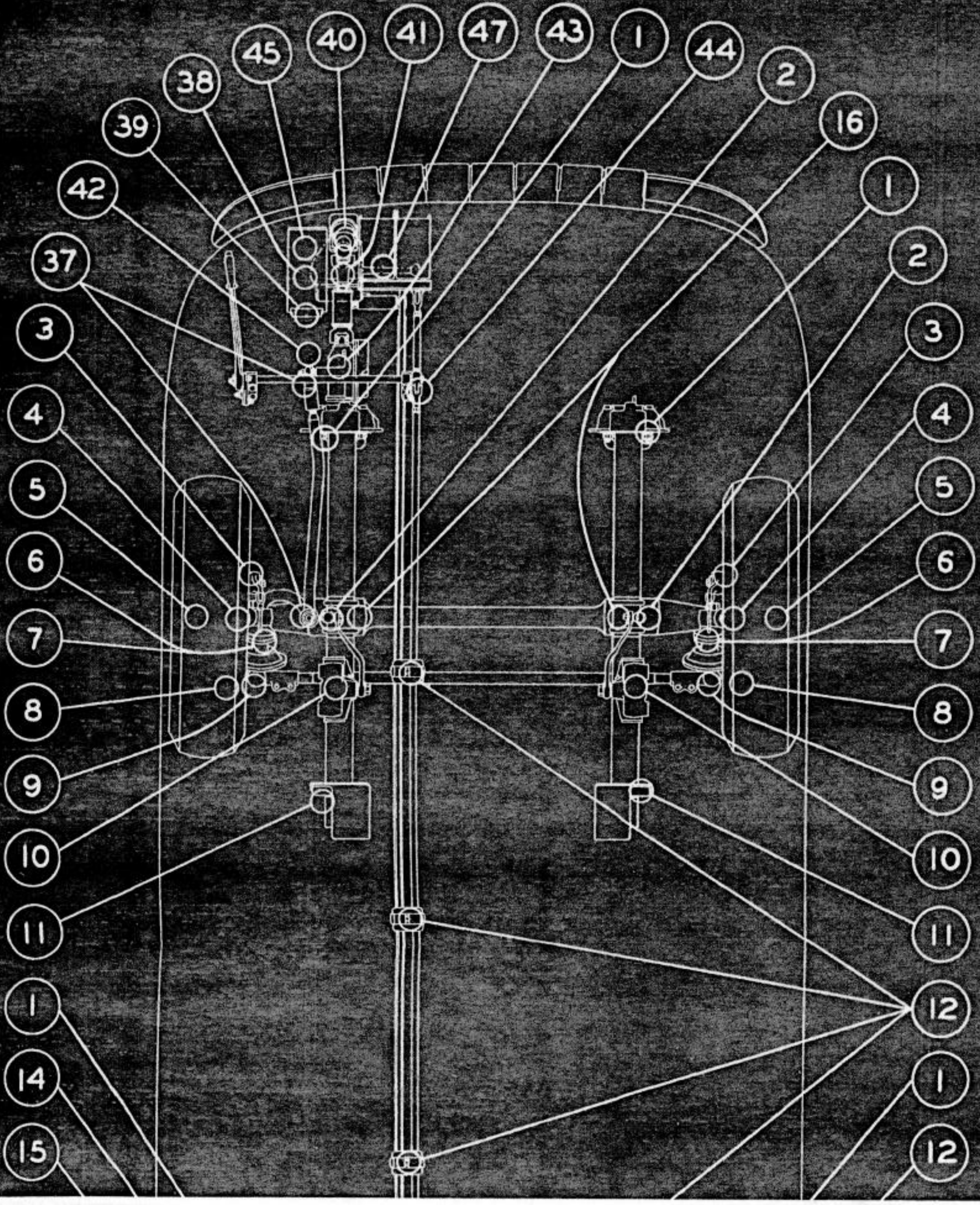
SPECIFICATIONS FOR "CORRECT LUBRICANT" APPEAR IN COLUMN No. 5 ON BACK OF THIS PAGE.

MODELS PGG 37 & 41 LUBRICATION CHART

FIRST EDITION

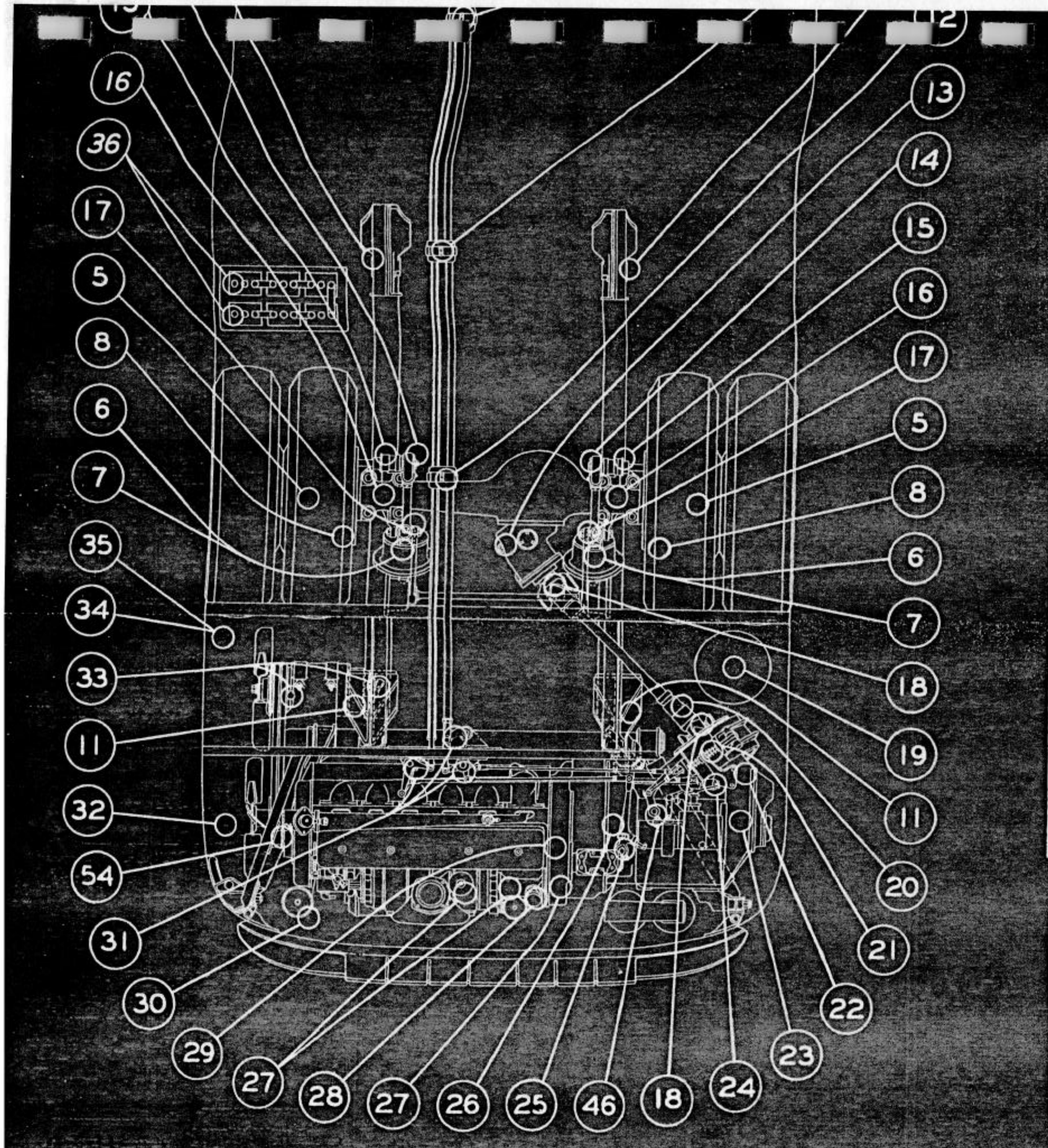
GMC FACTORY ENGINEERED LUBRICATION SERVICE

THIS PAGE SHOWS WHERE AND TELLS HOW OFTEN EACH ITEM SHOULD BE LUBRICATED



ITEMS TO BE LUBRICATED

DESCRIPTION	LUBRICATION PERIOD (MILES)	CORRECT LUBRICANT
1. Front and Rear Spring Eye	1000	C
2. Front Shock Absorber Link	1000	C
3. Front Brake Camshaft	1000	S2
3. Front Brake Slack Adjusters	1000	C
4. Steering Knuckle King Pin	1000	C
5. Front and Rear Wheel Bearings	10,000	S2
6. Front and Rear Air Chamber Clevis	1000	E
7. Front and Rear Air Chamber Boot	As Req'd	S8
8. Front and Rear Brake Shoe Anchor Pin	1000	S2
9. Tie Rod Ends	1000	C
10. Shock Absorbers	As Req'd	Spec.
11. Front and Rear Spring Shackles	1000	C
12. Control Rod Bearings	At Assy.	E
13. Differential	As Req'd	GS
14. Rear Brake Slack Adjuster	1000	C
15. Rear Brake Camshaft	1000	S2
16. Front and Rear Spring Center Bolt	1000	C
17. Sway Bar Link	1000	C
18. Prop. Shaft Universal Joints	1000	S1
19. Air Cleaner	As Req'd	E
20. Prop. Shaft Slip Joint	1000	C
21. Hand Brake Anchor	1000	C
22. Speedometer Adapter	1000	G
23. Transmission	As Req'd	ES
23. Transmission Air Shaft Cyl.	At Assy.	C
24. Clutch Release Bearing	1000	S2
25. Clutch Cross Shaft	1000	S2
26. Clutch Shaft Splines	At Assy.	S5
27. Starting Motor	1000	E
28. Engine	Daily	E
29. Clutch Pilot Bearing	5000	S2
30. Shutter Air Filter	As Req'd	E



29. Clutch Pilot Bearing	5000	[illegible]
30. Shutter Air Filter	As Req'd	E
31. Control Bell Cranks	1000	C
32. *Shutter Thermostat*	*5000*	*S10*
33. *Generator*	*1000*	*S2*
34. *Shutter Air Cylinders*	*5000*	*S11*
35. Shutter Linkage	5000	E
36. Battery Terminals	As Req'd	S3
37. Drag link Ends	1000	C
38. Steering Gear Bevel Gear Housing	1000	ES
39. Clutch Pedal Hinge Pin	As Req'd	E
40. Steering Column Top Bearing	At Assy.	S2
41. Steering Shaft Slip Joint	1000	C
41. Steering Shaft Universal Jts.	At Assy.	S1
42. Gear Shift Cross Shaft	1000	C
43. Steering Gear Worm Housing	1000	ES
44. Hand Brake Cross Shaft Brg.	At Assy.	C
45. Clutch Pedal Cross Shaft	1000	C
46. Hand Brake Idler Shaft Bell Crank	1000	C
47. Brake Application Valve	1000	E
*48. Crankcase Breathers	As Req'd	E
*49. Throttle and Choke Bearings	At Assy.	S1
*50. Carbureter Accelerator Pump Rod	1000	E
*51. Air Compressor Drive Univ. Jt.	1000	S1
*52. Distributors	1000	E-S3
*53. Air Compressor Drive Slip Jt.	1000	C
†54. Engine Fan Bearings	1000	S2

† Applies on Diesel Equipped Vehicles only.
* Applies on Gasoline Equipped Vehicles only.
All Other Points Apply on Both Types of Vehicles.

Note –

SPECIFICATIONS FOR "CORRECT LUBRICANT" APPEAR IN COLUMN No. 5 ON BACK OF THIS PAGE.

MODELS PDG 37 & 41 LUBRICATION CHART

Springs

Instructions and Illustrations in this Group Apply to Following Subjects:

Front Springs
Rear Springs
Shock Absorbers
Sway Bar
Lubrication Points

Instructions Applying to Related Parts of Springs will be found in Following Groups:

Name	Group
Front Axle	1.7601
Rear Axle	2.10281

Front and rear springs are semi-elliptic type and are provided with lubrication fittings through center bolts. Specifications are found at end of group.

A few coach units are equipped with parabolic-edge leaf springs. The difference, however, is in the design only. Mounting and lubrication is the same as described in following text.

Forward end of front spring is supported in stationary bracket provided with spring safety bar, as shown in Fig. 1. Rear end of front spring is shackled, as shown.

Rear springs are shackled at front end and pivoted at rear as illustrated in Fig. 2. Rear end of rear springs is provided with spring safety straps.

Spring shackle pins and pivot pins are threaded into spring eyes and bracket bushings. Pins are drilled to provide lubricant to bushings. Each pin has clip at one end to permit use of wrench when removing pin from bushing.

Pins are prevented from turning in shackles and brackets by clamp bolts and tapered draw keys.

Spring eye threaded bushings are pressed in place in spring eyes. Front spring rear shackle bracket and rear spring front shackle bracket bushings are notched at one end, and retaining washer bolted to bracket, engages notch, so as to hold bushing in place. Head of retaining bolt is wired to bracket.

INSPECTION

At regular intervals inspect shackle and pivot bolts and tighten if necessary. KEEP CENTER BOLT NUTS ALWAYS TIGHT. If center bolt nuts are not kept tight, spring leaves will not be efficiently lubricated.

SHOCK ABSORBERS

Front spring shock absorbers are heavy duty double-acting hydraulic type connected to axle with ball stud type links. Shock absorbers operate on principle of piston forcing fluid through a small orifice or hole, thereby building up necessary resistance to control vehicle body movement. When pressure is built up to a predetermined point, spring loaded relief valve will open and hold this constant pressure until completion of piston stroke.

Due to clearance between piston and piston chamber, and special fluid (Delco-Lovejoy) used, it is not necessary to change fluid to meet various climatic conditions.

Absorber units do not require special attention, except to periodically lubricate link joints, and to check fluid level in housings. Use only genuine Delco-Lovejoy fluid, and check level at least every 10,000 miles.

While these units are constructed in a manner to permit overhaul in service, it is recommended that repairs be made by Delco-Lovejoy Service Stations whenever possible. These stations are equipped with necessary tools and equipment, and are familiar with all phases of absorber service.

Need of major overhaul service may be readily determined by following conditions:

1. Absorber body or arm broken.
2. Absorber leaks at arm.
3. Arm stuck or "frozen".
4. No resistance in absorber when arm is moved up and down, after checking to see if it is full of fluid.

If any of above conditions exist, remove absorber from vehicle, replace with new unit or overhaul in following manner:

15

1. Remove dirt, grease, and loose paint from outside of absorber.
2. Place absorber in assembly fixture and remove cover. CAUTION: Do not place unit in vise as pressure on cylinder will bind piston.
3. Remove arm, packing gland and washers.
4. Wash all parts in kerosene.
5. Inspect parts and make necessary replacements.
6. Assemble absorber arm with NEW packing gland and washers in body.
7. Refill to capacity with new fluid.
8. Replace cover.
9. Reinstall unit, making sure it is tight to frame. Inspect links and connections. Paint absorber and fittings if necessary.

Tools, assembly fixtures, and parts may be obtained from any local Delco-Lovejoy Service Statione.

Anchoring of shock absorber is reinforced with extruded aluminum channels riveted to frame. See Fig. 3. To facilitate shock absorber removal, the unit proper is provided with additional spacer plate held in position in shock absorber by means of two center cap screws, which reach as far as shock absorber cylinder. Holes large enough to clear cap screw heads are drilled in frame, through reinforcing channel and tapping plate.

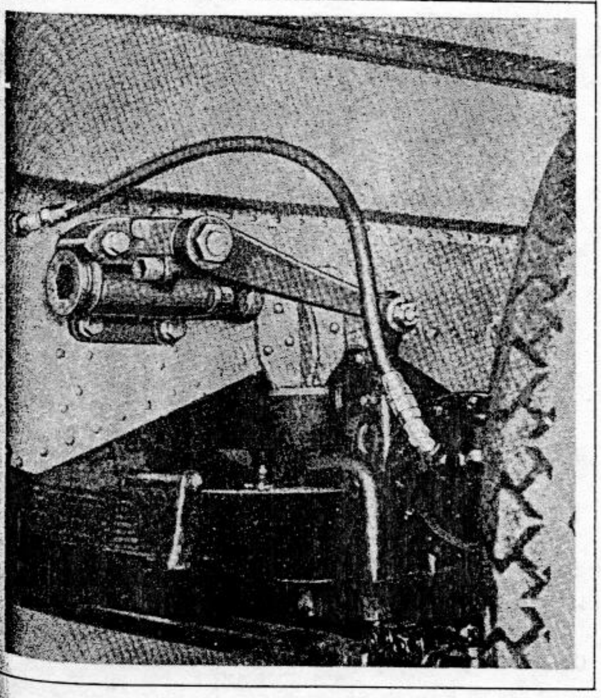


Fig. 2. Front Shock Absorber Mounting.

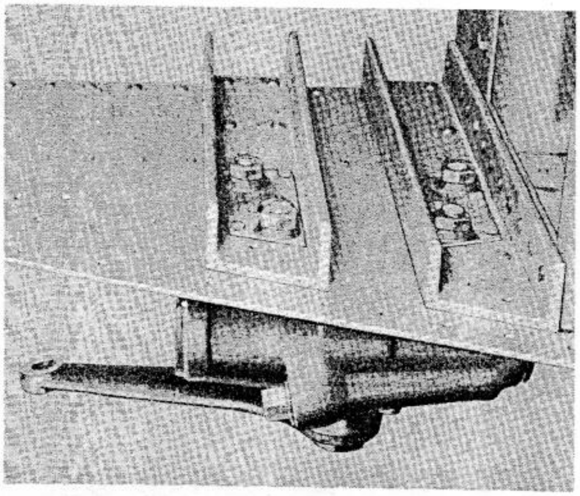


Fig. 3. Showing Shock Absorber Tapping Plate.

Removal of shock absorber is made by removing two long top shock absorber screws and two short spacer plate screws, at bottom. Screw nuts are securely welded to tapping plate in reinforcement channel. (See Fig.3)

Shock absorber arm links are provided with two lubrication fittings facing toward rear.

REAR SPRING SWAY BAR

Construction of rear spring sway bar and connecting links is shown in Fig. 5. Entire assembly is mounted in a rigid anchor bracket and spacer riveted to coach frame. Connecting levers are securely welded to bar on one end and attached to link on the other end. Rubber cushion is vulcanized to a small and a large sheet metal plate. Small metal plate end is bolted to lever flange. Large metal plate is bolted to anchor bracket and anchor bracket spacer.

Action of sway bar is to equalize swaying or rolling tendency of rear end of coach, especially when going around corners. Rubber stock, about 2" thick, will deflect torsionally one plate in respect to the other, 6.7 degrees, approximately, at 100 lbs. at 10" radius. The deflection along the arc at 10" radius will be 1.17 inches approximately.

Sway bar installation does not require any special attention except to see that unit is kept rigidly mounted and that links are periodically lubricated with chassis grease as shown in Lubrication chart.

Steering Gear

Instructions and Illustrations in this Group Apply on Following Subjects:

Steering Column and Shaft Assembly
Steering Shaft Bevel Gears
Steering Control Universal Jointed Shaft
Steering Gear Proper
Drag Link
Lubrication Points
Specifications

Instructions Applying to Related Units of Steering Gear will be found in Following Groups:

Name	Group
Front Axle	1.7601
Wheels	19.9101

Steering gear, Fig. 1, is cam and roller twin lever type, and is connected to steering arm on left hand steering knuckle by means of steering drag link. Only contact between actuating and actuated members of gear is rolling-line-contact between lever studs and cam thread as shown in Fig. 1. Clearance between studs and cam can be adjusted by means of screw and lock-nut, accessible from under driver's seat, through air duct as later described.

OPERATION

The essential operation of the gear is same as conventional type gear except steering effort is transmitted to steering gear proper by means of bevel gears and a universal jointed shaft. The two lever shaft studs, in steering gear proper, are designed to operate in such a manner as to give effective steering with a minimum of steering effort. Cam grooves are cut shallower in straight ahead driving position of each stud to produce a high point in the groove (equal at each stud) that causes closer mesh of studs in groove through mid-position of travel of each stud. At points other than straight ahead driving position, more clearance is provided for studs to allow free action. This feature permits compensation for wear, by adjusting studs into grooves after such wear has occured at "high point", without causing studs to bind at other points in grooves. Groove sides are on a uniform angle designed to fit against stud taper in any position. Thus, it will be seen that varying depth of groove makes for what might be termed a high range or support at those points where groove is shallower. In this manner a very sensitive adjustment is permissable.

HOUSING

Steering column is supported at its upper end by shroud castings which are mounted to arch panel by bolts, accessible from center panel compartment hand hole and through instrument panel compartment. Steering column upper support shroud consists of two sections. Left section is bolted to right section by three cap screws. Right section is bolted to arch panel by means of bolts accessible through center panel compartment hand hole.

Lower end of steering shaft is rigidly mounted to body bracket by means of large cap screw, accessible through fog lamp opening.

Steering gear universal joint is housed in steering gear shroud, and is easily accessible by removing shroud cover screws on both sides of shroud.

Steering gear proper is housed between tool compartment and air duct or control rod box.

REMOVING STEERING GEAR COLUMN ASSEMBLY

1. Remove left hand driver's seat bracket screws, one in front of seat and two in rear.
2. Remove seat, tilting as it is being lifted.
3. Unscrew and lift air duct cover under driver's seat.
4. Remove air duct cover rubber seal. (Make sure seal is properly installed when reassembling.

STEERING GEAR

5. Remove straddle box cover screws on both sides and uncover straddle box. This exposes steering universal joint.
6. Remove snap finish moulding at bottom of instrument panel.
7. Disconnect gear shift control rod by removing yoke pin on control rod, under seat, at lower end. Make sure distance is marked so as not to disturb gear shift adjustment when assembling.
8. Disconnect universal joint at post by removing two "U" bolts.
9. Slide joint back to clear bearing seats.
10. Disconnect grease and grease overflow tubes.
11. Remove three screws holding steering post dash left half housing casting.
12. Disconnect battery.
13. Remove center panel screws and swing out panel, but do not remove.
14. Unscrew right hand housing through hand hole at left of compartment and lift housing.
15. Remove steering column cap screws.
16. Remove left hand fog lamp.
17. Unscrew cap screw at base of steering shaft, through fog lamp opening.
18. Disconnect horn wire.
19. Lift entire steering column and shaft assembly.

REMOVING STEERING GEAR UNIVERSAL JOINT

1. Remove straddle box cover.
2. Remove "U" bolts at steering post.
3. Remove "U" bolts at lower end through tool compartment.
4. Disconnect grease and grease overflow tubes.
5. Disconnect gear shift control rod by removing yoke pin on control rod. Make sure distance is marked so as not to disturb gear shift adjustment.
6. Lift universal joint.

REMOVING STEERING GEAR

Steering gear assembly is accessible through tool compartment and is removed as follows:

1. Remove jack from tool compartment.
2. Disconnect steering connecting rod from pitman arm.
3. Remove gear shift cross shaft lubricant overflow tube.

. Unscrew universal joint lower "U" bolts, remove pin, and disconnect joint from steering gear assembly.

5. Remove two gear housing side plate upper long head cap screws, screwed to tapping plate riveted to air duct wall.
6. Remove two gear housing side plate lower bolts, accessible through spare tire compartment. See "Body" group.
7. Pull steering gear assembly out through tool compartment.

On some vehicles, top gear assembly is bolted to air duct wall by two short head bolts with nuts and washers, accessible from under driver's seat, in which case seat and air duct top cover must be removed, as well as elbow turn assembly and left hand wall insulation pad.

STEERING GEAR ADJUSTMENTS

Consideration must be given not only to adjustment instructions outlined in this group, but also to the pertinent instructions given in other groups of this book which describe allied units of the steering gear. Particularly important are the front wheel alignment instructions outlined in "Front Axle" group.

Steering difficulties are caused not only by steering gear misalignments, but by one or a combination of incorrect adjustments of any part of the entire steering and front axle control mechanism. The adjustments required on steering gear proper are extremely important; however, equal consideration must be given to maintenance of all steering control units in order to accomplish safe steering.

While adjustments of the steering gear proper should be made independent of other alignment operations, incorrect adjustment of steering gear will affect entire steering system.

1. When preparing to made adjustments, first free steering wheel of all load, preferably by disconnecting steering connecting rod from pitman arm. Next, loosen instrument board bracket clamp on steering gear jacket tube.

   If ball thrust bearings on cam must be adjusted, make this adjustment (A) before making side adjustment (B). (See Fig. 1).

ADJUSTMENT (A) OF BALL THRUST BEARINGS ON CAM

Adjust to barely perceptible drag so that steering wheel can be turned freely, with thumb and forefinger lightly gripping rim.

Before making this adjustment, loosen

Fig. 1 Steering Gear Assembly

housing side cover adjusting screw lock nut (1), see Fig. 1, and back off adjusting screw (2) a few turns to free studs in cam groove. Then unscrew four nuts which attach housing lower cover and pull cover partially outward to permit removal of shims. (Shims are of .003" and .010" thickness).

Clip and remove a .003" shim or more as required. Tighten all four nuts. Draw down tight. Test adjustment and if necessary, remove or replace shims until adjustment is correct.

ADJUSTMENT (B) FOR MINIMUM BACKLASH OF TAPERED STUDS IN CAM GROOVE

Since larger portion of driving is done when travelling in an approximately straight line, more wear occurs in steering gear within about one-quarter wheel turn either side of straight-ahead position. For this reason, within this range, width of cam groove is narrower than elsewhere, making it possible to adjust gear for wear without binding in extreme positions. It is important to note that steering gear width of groove must be adjusted at place when width of grooves is narrowest; that is within straight-ahead driving range of one half wheel turn.

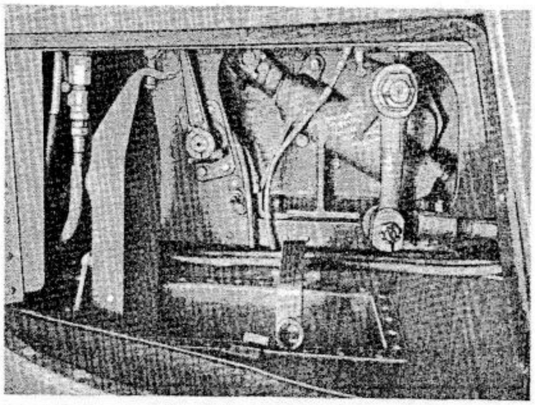
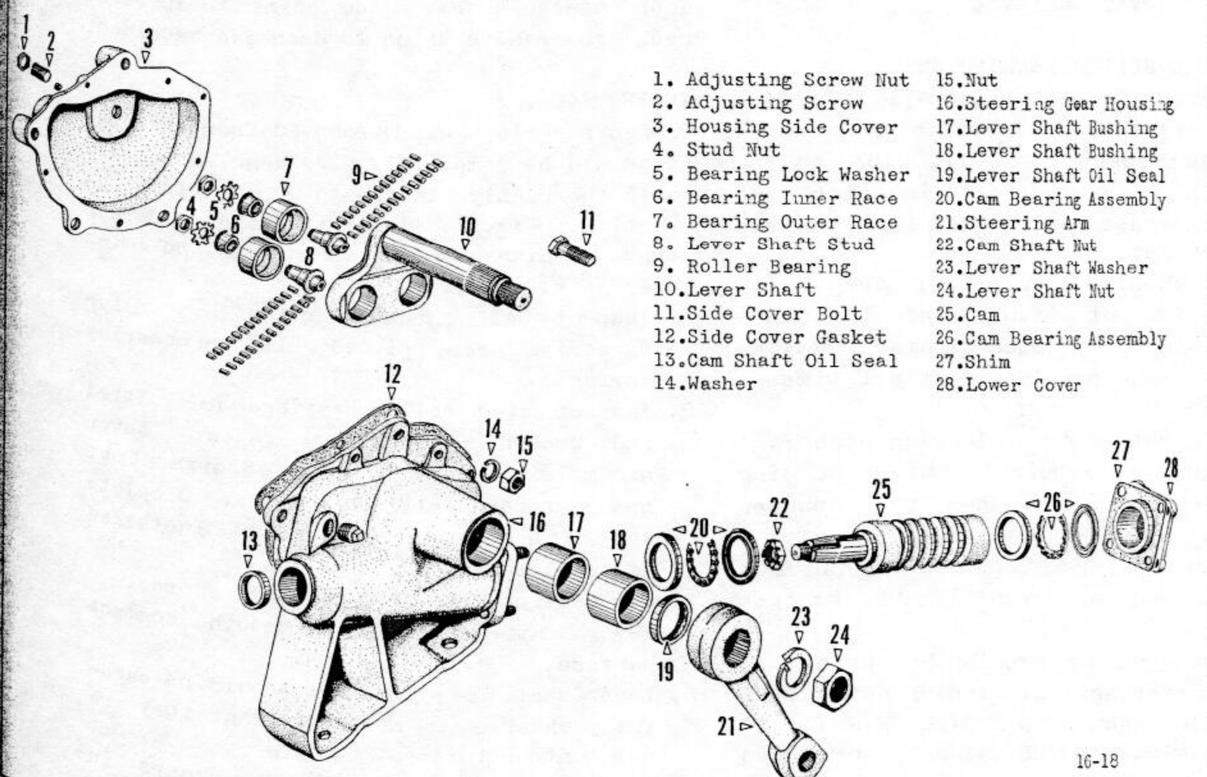


Fig. 4 Steering Housing is Accessible Through Tool Compartment.

Although adjustment of lever shaft thrust screw will be greatly simplified if steering gear has been removed from chassis; the adjustment can be accomplished with steering gear in place; as follows:

Adjusting screw (2) is accessible by removing:



1. Adjusting Screw Nut
2. Adjusting Screw
3. Housing Side Cover
4. Stud Nut
5. Bearing Lock Washer
6. Bearing Inner Race
7. Bearing Outer Race
8. Lever Shaft Stud
9. Roller Bearing
10. Lever Shaft
11. Side Cover Bolt
12. Side Cover Gasket
13. Cam Shaft Oil Seal
14. Washer
15. Nut
16. Steering Gear Housing
17. Lever Shaft Bushing
18. Lever Shaft Bushing
19. Lever Shaft Oil Seal
20. Cam Bearing Assembly
21. Steering Arm
22. Cam Shaft Nut
23. Lever Shaft Washer
24. Lever Shaft Nut
25. Cam
26. Cam Bearing Assembly
27. Shim
28. Lower Cover

Fig. 5 Component Parts of Steering Gear.

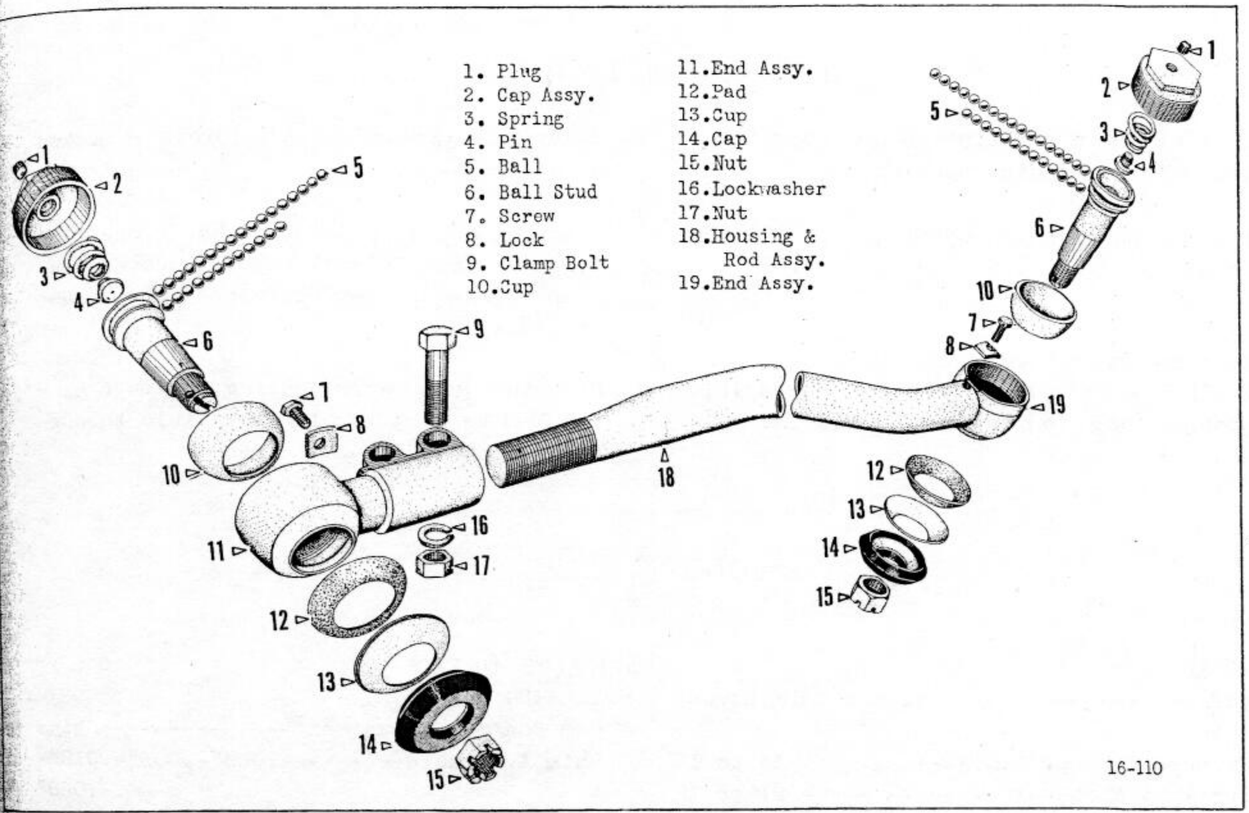


Fig. 6 Component Parts of Drag Link

Satisfactory results cannot be assured unless all parts are replaced. Do not assemble stud bearings with new and used rollers together. Bearing rollers are serviced only in complete sets.

PITMAN ARM INSTALLATION

It it has been necessary to remove Pitman arm, it must be reinstalled in proper relation to cam lever shaft to assure lever studs being in center of cam when front wheels are straight ahead.

Ascertain center first by turning steering wheel two and a half turns from extreme left position toward right. Then place pitman arm in position so that lever shaft end mark corresponds with marks on pitman arm.

STEERING DRAG LINK

Drag link connects steering gear Pitman arm at forward end and steering knuckle arm at rear. Forward end of this rod is threaded onto tube and held tight by two clamp bolts. Adjustment of this rod should never require attention, however, except at overhaul or installation of new parts which might affect relation of steering wheels. When steering connecting rod is properly adjusted, steering wheel should be exactly half way between extreme right hand and left hand positions when front wheels are straight ahead.

To adjust steering connecting rod:

1. Disconnect forward connecting rod end assembly from Pitman arm.
2. Loosen clamping bolts at connecting rod forward end assembly.
3. Place front wheels exactly atraight ahead.
4. Place steering wheel in mid position by turning wheel first to extreme right position and then counting number of turns required to reach extreme left hand position. Then move steering wheel back exactly half way.
5. Adjust connecting rod clamping end until connecting rod clamping end assembly can be installed in Pitman arm without bind and without altering straight-ahead position of front wheels.

Transmission

Instructions and illustrations in this Group apply to Following Subjects:

Transmission	Service Information
Transmission Mounting	Lubrication

Instructions applying to Related Parts of Transmission will be found in the Following Groups:

Name	Group No.
Air Lines	4.10401
Transmission Removal	8.7101
Clutch	5.8401
Governor	12.8901

Transmission assembly, Fig. 1, is transverse mounted with engine, and can be removed with power plant or separately, as explained in Engine group of this book.

For convenience of explaining various service procedures, clutch end of transmission is designated in the instructions as "Front" and angle drive end as "Rear".

Transmission has four speeds forward and one reverse. Shifting operations are explained under "Shifting Mechanism".

GEARS AND SHAFTS

All gears on mainshaft and countershaft have helical cut teeth, and are in constant mesh. Interlocking clutch collars with spur cut teeth on inner diameter slide over corresponding teeth on clutch gears.

MAINSHAFT AND GEARS

Mainshaft is supported at rear end by opposed tapered roller bearing mounted in angle drive case cover. Straight roller bearing, mounted in case directly in front of bevel pinion supports shaft at that point. Front of mainshaft is supported in pocket by roller bearing mounted in main drive gear. Main drive gear and shaft are supported in case on single row annular ball bearing.

Mainshaft third and fourth speed stationary clutch gear is mounted directly on splined portion of shaft and held in place with nut and locking washer. First and second speed stationary clutch gear is integral with shaft.

Mainshaft first, second and third speed constant mesh gears are each mounted on double row special needle bearings. Rows of bearings under each gear are separated with spacer. Bearings are held in place on shaft by shoulders or thrust washers of opposite gears.

COUNTERSHAFT AND GEARS

Countershaft is supported at rear on single row annular ball bearing held on shaft with two locking nuts and one locking washer. Front end of shaft is supported on roller type bearing which is held in place by clutch housing. Inner race of bearing is held on shaft with nut and washer.

Countershaft drive and third speed gears are keyed to shaft with two keys and separated with a spacer. Second speed helical gear and reverse clutch gear are integral with shaft.

First speed gear on countershaft is not keyed to shaft, but is carried on bronze bushing and is driven by sliding clutch carried on splined countershaft. This clutch is operated by reverse shifting fork and is engaged in all forward speeds. Operation of this clutch with relation to reverse gearing is described in following paragraphs.

REVERSE GEARS

Reverse idler gears are mounted on needle type roller bearings, with two sets of rollers under each gear. Spacers are used between adjacent sets of rollers. See Fig. 2.

Unlike conventional transmissions, reverse idler gears are separate and both turn freely on their bearings. Driven idler gear is in constant mesh with helical second speed gear on countershaft and driving idler gear is in constant mesh with low speed gear on countershaft. As noted in preceding paragraphs, countershaft low speed gear revolves on bronze bushing and is driven by sliding clutch in all forward gear positions.

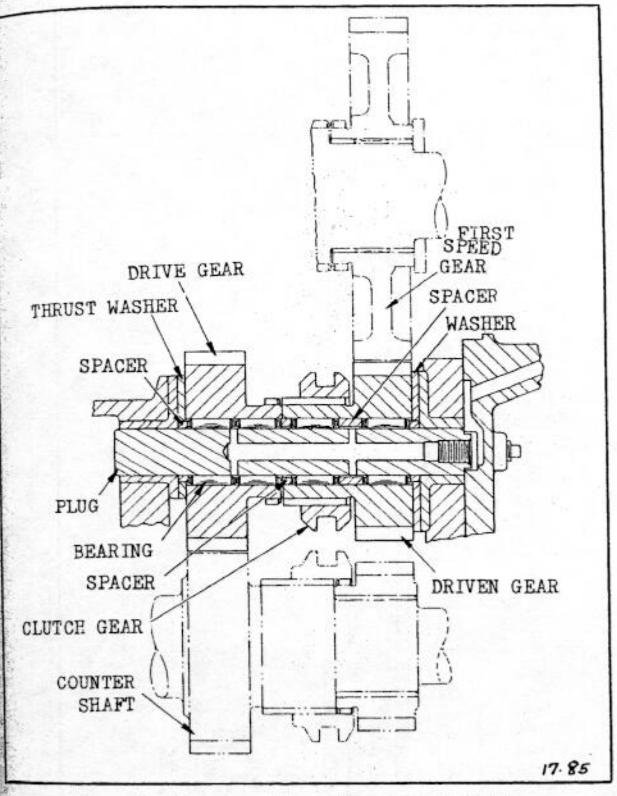


Fig. 2 Reverse Idler Gears and Shaft.

Reverse power path is through countershaft driven gear to countershaft second speed gear, to reverse idler driven gear through sliding clutch, to reverse idler drive gear, to countershaft low speed gear, to mainshaft low speed gear and through first and second gear sliding clutch to mainshaft. See Fig. 2.

OIL PUMP

Transmission lubricating oil is circulated by means of a gear type oil pump, as shown in Fig. 1. Oil pump is contained in a housing mounted on angle gear side of case. Oil pump drive is through hex shaft which fits in end of countershaft.

Drive gear has hub projections on both sides which fit into housing. Driven gear is bushed and turns on shaft pressed into housing. Pump is fitted with pressure relief valve, consisting of a ball and spring held in place by screw type plug which is wired into position.

REPLACEMENT

Whenever oil pump is removed from case or disassembled, install as follows:

1. Fill oil pump housing full of lubricant before bolting assembly in place.
2. Remove screw holding oil relief spring and fill with lubricant.
3. Rotate clutch shaft in proper direction while filling until all oil passages are filled and air is displaced. Unless oil pump is filled with lubricant, it may not pick up when first started, thereby chances of damage through lack of sufficient lubricant are increased.

SHIFTING MECHANISM

Shifting of transmission gears to various forward speeds and reverse is accomplished with manually operated shifting lever with the assistance of an air operated selecting cylinder mounted on transmission cover. The air operated selecting cylinder is charged by action of air valve interconnected with driver shifting lever.

The manual shift lever and air valve linkage is illustrated in Fig. 3, while selecting cylinder mounting and mechanical connections, is illustrated in Fig. 4. Air Line Connections,

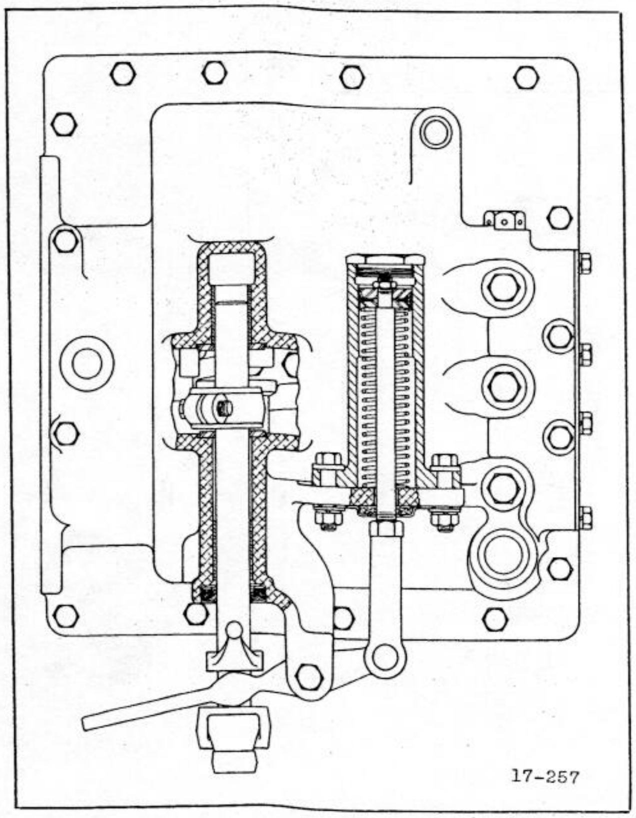


Fig. 3 Selector Cylinder and Linkage.

are shown on Air Line Diagram in "Brakes" group of this book.

The actual shifting to various speeds is accomplished in following manner:

1. NEUTRAL. The normal or "Neutral" position of manually operated shifting lever at front is in position to shift to third or fourth speeds. In this position, the shift shaft on transmission cover, Fig. 2, is in third or fourth speed position, permitting the selection of either speed by manual manipulation of shifting lever. The air operated selecting cylinder does not assist in positioning of third and fourth speed gears.
2. FIRST SPEED. As shift lever is raised up, air valve, Fig. 4, interconnected with lever, is opened momentarily to permit air to selecting cylinder at transmission. Operation of selecting cylinder positions shift shaft at transmission on first and second speed rail. Air is then exhausted from cylinder; however, shift rails are held in position until gears are manually meshed. Shifting lever is then manually pushed forward, thus meshing first speed gears through medium of control rods and linkage from shifting lever to transmission.
3. SECOND SPEED. Shifting lever is pulled straight back, thus meshing second speed gears in transmission.
4. THIRD SPEED. Shifting lever is pushed forward to center position, and then straight down. Shifting lever is then pushed forward manually to complete meshing of third speed gear.
5. FOURTH SPEED. Shifting lever is pulled back to extreme position to complete meshing of fourth speed gear.
6. REVERSE. To position and mesh reverse gear, it is necessary that shifting lever be raised up from "neutral" and pushed forward to first speed position, as described in paragraph No. 2. The lever knob must then be pulled out and as knob is held out lever is raised directly upward, and then pulled straight back. The action of air valve and selecting cylinder during preliminary movement of shifting lever (from neutral to first speed position) is explained in Paragraph 2. As lever knob is pulled out and lever raised from first speed position, action of selecting valve and linkage permits selecting cylinder to position transmission shift shaft on reverse rail. As lever is pulled back to reverse position, reverse gears are manually meshed by action of linkage from lever to transmission. Action of transmission gears in reverse is explained under "Operation of Reverse Mechanism".

MANUAL OPERATION OF DRIVER'S LEVER

Bear in mind that the shifting of gears in this transmission is not automatic. The selecting cylinder merely positions transmission shift shaft. The actual manual effort or technique used is same as is necessary to use on any other manually shifted transmissions. The operator should have a degree of "feel" when shifting from one speed to another. This technique is particularly necessary when shifting into reverse. The shifting of lever into reverse should not be a quick continuous movement, but in successive steps with a slight pause at end of each step, "feeling" the meshing of gears on the last movement of shifting lever.

CAUTION: When shifting out of reverse gear, particular care should be taken to move the shifting lever back in same path taken to make original selection. The lever must be pushed straight forward and then down to first speed position. If shifting lever is moved through center position and then to first, the gears in transmission will not be correctly positioned for first speed.

Do not attempt to shift gears unless air pressure is at least 60 lbs.

ENGINE SPEEDS

Flexible cable connected to shift shaft on transmission and engine governor automatically changes setting of governor to permit higher engine speeds while transmission is engaged in first, second, third and reverse speeds. In this manner, operation of lower speed gears is not limited to specified high speed governor setting.

Description and instructions of governor used on gasoline engine are shown in "Fuel (Gasoline)" group of this book. Instructions regarding Diesel engine governor are shown in Diesel Operating Manual.

MANUAL SHIFTING

A manual shifting rod is installed on trans-

Fig. 4 Transmission Shifting Control Linkage.

OUTPUT SHAFT ASSEMBLY

1. After universal joint yoke flange and outer bearing cap is removed, outer bearings can be withdrawn with cage. Retain shims, located between bearing retainer and housing.
2. Pull output shaft and inner bearing through inner end of housing.

INSPECTION OF PARTS

Clean all parts carefully in gasoline or kerosene and blow dry with compressed air.

All bearings should be given more than a cursory cleaning. After bearing assemblies have been soaked in gasoline, tap them sharply on a block of wood to dislodge any solid particles. Slush them again in gasoline and blow dry with air. To not spin the bearings with the air - revolve them slowly in races with fingers as air is directed at right angles to the balls or rollers. Examine races and bearings for pits and scores, then oil each assembly thoroughly with clean engine oil.

Individual needle bearings which were removed from mainshaft gears should be thoroughly washed and inspected. Replace those bearing needles which show signs of scores or pits. (There are 138 needles to each gear.)

Examine teeth on all gears carefully for nicks and worn spots. Do not take chances with gears which are appreciably nicked or scored. Small nicks may be carefully removed with a slip-stone or hone.

ASSEMBLING TRANSMISSION

Procedures as outlined in following paragraphs have been tested in actual service; therefore, in order to assemble transmission with minimum time and effort, it is recommended that practices as outlined be followed carefully.

CLUTCH HOUSING

Two dowel pins, held in clutch housing with snap rings, locate clutch housing on main case. In production, the clutch housing is bolted in place with drive shaft bearing retainer in place; the dowel pin holes in both case and housing are line reamed, and dowels installed; and then a finish cut is taken on shoulder of clutch housing to align housing concentric with mainshaft.

Service clutch housings are machined in same manner before shipment except that dowel holes are not reamed. Dowel holes are left undersize. When clutch housing is replaced with new part, bolt housing to main case in same manner (with main drive gear bearing retainer bolted in place). Line ream dowel holes in clutch housing to dimension shown in "Specifications". Then ream clutch housing dowel holes only to dimensions listed in "Specifications" under Clutch group. Install dowels and snap rings.

If clutch housing has been removed for other repair purposes, renew gasket between housing and case before reinstalling. Always temporarily install main drive gear bearing retainer before bolting housing to case to assist aligning housing and case.

Refer to "Clutch" group of this book for instructions covering clutch shifter shaft.

MAIN CASE

Clean interior of main case thoroughly. Remove magnetic drain plug and clean all particles of metal from magnet. Blow out all oil passages with compressed air.

REAR CASE

Rear case assembly, which contains output shaft assembly, is aligned on main case with two dowel pins which are retained in case with snap rings.

In production, the rear case is bolted in place on main case with center bearing retainer in place and then dowel holes in main case and rear case are line reamed. If rear case casting is renewed, assemble rear case and cover to transmission with both center and rear bearing retainers and bearings in place, and without use of dowels. Shift cover as necessary so that when bolts are tightened, main shaft turns freely. Line ream dowel holes in flanges of new parts only to dimension shown in "Specifications". Then disassemble and line ream flanges of new case or cover to dimensions listed in "Specifications".

Blow out all oil passages in case, and clean magnetic drain plug.

ASSEMBLING COUNTERSHAFT AND GEAR

With clutch housing installed on main case, proceed to assemble balance of transmission end of shaft is in place.

2. As shaft is driven into case, install remaining parts.
3. Front thrust washer fits in notch in case.
4. After shaft is driven into case, tongue on outer end of shaft must be in vertical position to register with recess in rear case.

ANGLE DRIVE TOOTH CONTACT AND BACKLASH

Particular care should be used when assembling output shaft assembly and bevel gear. Pinions must have correct amount of backlash and tooth contact after assembly. Shims of various thickness are placed between bearing retainer and housing at both the output shaft and at the rear of main shaft. These shims provide correct tooth contact and backlash.

If necessary to replace either pinion, matched set should be used. The gears are matched and lapped for service replacement.

In production, pinions are carefully adjusted for backlash and tooth contact. When original pinions are reinstalled, original shims should be used. In most instances, use or original shims will obtain correct tooth contact and backlash when new gears are installed. Tooth contact and backlash may be of original shims will obtain correct tooth contact and backlash when new gears are installed. Tooth contact and backlash may be checked in following manner: Refer to Fig. 1.

1. Install angle drive pinion in housing with bearings in place - do not install bearing cap, propeller shaft flange or shims (A), under bearing retainer make sure that double row bearing seats firmly in retainer.
2. Hold bearing in place temporarily with a 3" spacer.
3. Install original pinion spacer (B) on mainshaft back of center bearing.
4. Install pinion gear on shaft.
5. Assemble rear case unit to main case. Make sure that marked teeth on new gears match.
6. Install main shaft spacer (C) and retainer with bearing. Do not install shims (D) between retainer and case.
7. Draw up tightly on bearing with one main bearing nut.
8. Adjust main shaft to best line up of gears by means of screws in puller holes of retainer (E). Bearing must be fully seated in retainer.
9. Measure space between retainer and housing with feeler gauge. Select proper number of shims, adding .005" to .008" to compensate for compression.
10. Remove bearing retainer and install shims selected. Tighten bearing with one nut. Check gear line up again.
11. Adjust backlash (see "Specifications") by moving angle drive gear in or out by means of screws in puller holes in retainer (F). Establish correct backlash. Be sure that bearing is seating firmly in retainer during this period.
12. Measure space between retainer (F) and case with feeler gauge. Select proper number of shims, adding .005" - .008" to compensate for compression.
13. Remove retainer and install shims selected. Check backlash again. Install propeller shaft flange.
14. Paint 8 or 10 teeth with mixture of red lead and oil. Turn mainshaft in direction of driving rotation. At the same time, place tension on propeller shaft flange with a rope or block of wood.
15. Desirable tooth contact should be at toe of tooth and running back approximately three-quarters of tooth length toward heel on drive side. Contact should be evenly distributed over face and flank of tooth indicating center of contact on pitch line. Refer to (B) on Fig. 5.
16. Tooth contact chart, Fig. 5, illustrates typical tooth contacts and remedial measures. This chart is same as is used for "Rear Axle", however, the same principle applies to the angle gears used in this transmission. "Pinion" referred to on chart will designate the angle drive bevel gear.
17. If tooth contact favors the heel or large end of tooth as at "C", Fig. 5, move bevel gear toward pinion gear by reducing shim thickness (A), Fig. 1, behind retainer and restore proper backlash by adding shims behind mainshaft rear bearing retainer, (D) Fig. 1.
18. If tooth contact at toe end is appreciably less than three-quarters of the length of tooth, as at (D) Fig. 5, move bevel gear away from pinion gear by adding shims behind retainer (A) Fig. 1. Restore proper backlash by reducing shim thickness behind mainshaft bearing retainer.

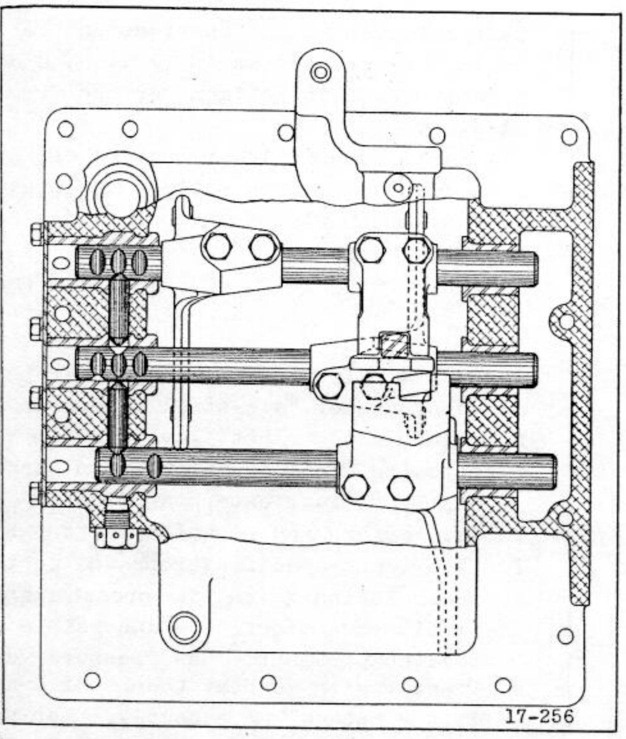


Fig. 6 Transmission Shift Rails

19. If contact is low on flank of tooth, as at (E) Fig. 5, move pinion gear away from bevel gear by reducing shim thickness behind mainshaft bearing retainer (D) Fig. 1, and restore backlash by adding shims behind pinion bearing retainer. (A) Fig. 1.

20. If tooth contact is high on face of tooth as at (F) Fig. 5, move pinion gear toward bevel gear by adding shims behind mainshaft bearing retainer (D) Fig. 1, and restore backlash by reducing shim thickness behind bevel gear bearing retainer. (A) Fig. 1.

21. If it becomes necessary to increase or reduce shim thickness behind mainshaft bearing retainer more than original thickness, change spacer (B) Fig. 1, to one which will allow the shim thickness variation behind mainshaft bearing retainer to remain at original thickness. Spacers are furnished in three thicknesses.

SHIFTING MAINTENANCE

Install shifting forks and rails as shown in Fig. 6. With rails and forks in position as shown, install transmission cover.

After transmission assembly is installed on power plant and in chassis, connect selecting cylinder linkage to bell crank and transmission shift shaft. Before connecting forward control linkage to transmission, place shifting lever at front in third or fourth speed position. Place transmission gears in third or fourth speed position with manual rod at transmission. Connect linkage to transmission control rod. Then adjust selecting cylinder operating rod so that rod bottoms in piston and clevis are free.

Move shifting lever at front into first speed position. As lever passes through center position, watch action of selecting cylinder on transmission. Movement of cylinder rod should position shift shaft to first and second speed position. If cylinder operating rod is correctly adjusted, actual meshing of first or second speed gears can be accomplished readily.

Note also action of selecting cylinder during movement of lever to reverse position.

AIR VALVE

Positioning cylinder air valve is interconnected to shifting lever, as shown in Fig. 4. When shifting lever is moved to first or reverse positions, valve push rod pushes valve plunger down, thus permitting air to selecting cylinder. Further movement of shifting lever releases valve push rod and spring pulls plunger back to exhaust position.

If necessary to disassemble the forward shifting mechanism, reassemble and adjust the valve push rod so that valve is on exhaust position when shifting lever is at "neutral". When shifting lever is in center of "upward" movement (or on high point of quadrant), valve push rod travel should be sufficient to allow full charge of air to selecting cylinder. As shifting lever is further moved, retracting spring should pull plunger back allowing immediate exhaust of air.

SPECIFICATIONS

TYPE-----------------------4 Speed Synchro
SPEEDS--------4 Speeds Forward - 1 Reverse

GEAR RATIOS
First--------------------------4.36 to 1
Second-------------------------2.84 to 1
Third--------------------------1.70 to 1
Fourth--------------------------1. to 1
Reverse------------------------3.72 to 1

BEARING ADJUSTMENT
Angle Drive Tapered Bearings----------No Perceptible End Play
Shims Available---------.003"-.010"-.030"
Spacer Thickness--------------.373"-.377"

OUTPUT DRIVE PINION - Spacers Available
(B - Fig. 1)------------------.230"-.245"

PINION AND GEAR BACK LASH------------.008"
Shims Available (A and D - Fig. 1)----------.003"-.010"-.031"

THRUST WASHERS
Mainshaft 1st Speed Gear - Thickness-------.262"-.266"
Countershaft 1st Speed Gear Thickness------.249"-.245"
Reverse Gear - Front - Thickness----.182"--.187"
Reverse Gear - Rear Thickness-.185"-.187"

BEVEL GEAR SPACER-THICKNESS
(C Fig. 1)--------------------.948"-.938"
Countershaft 1st Speed Gear Bushing---I.D.----2.346"-2.349"-2.3595"

OIL PUMP
Gear Back Lash----------------.006"-.008"
Gear Width--------------------.623"-.622"
Bushing - Length--------------.623"-.622"
Bushing - Burnish to--------.5005"-.4990"
Bushing - Shaft Clearance----.001"-.0035"
Pressure Relief Spring
Free Length-----------------------2-7/16"
Lbs. Pressure @ 2"-----------------3-1/2"
Rear Case and Cover Reaming Instructions

REAR CASE
Line Rear New Case Flange to--.751"-.749"
Disassemble and Re-rear Case Flanges Only to-------------------.7730"-.7745"
REAR CASE COVER
Bolt Cover in Place - Locate From Bearing and Line Ream Flanges to------.624"-.623"
Re-Ream Cover Flanges Only to------.6250"------.6255"

CLUTCH COVER
See "Clutch" Group for Reaming Dimensions

Propeller Shafts

Illustrations and Descriptions in This Group Apply to Following Subjects:

Propeller Shaft
Lubrication
Universal Joints

Instructions Applying to Related Parts Will be Found in Following Groups:

Name	Group
Rear Axle	2.10281
Transmission	17.11101

Propeller shaft, between transmission and differential, is solid type fitted with heavy duty needle bearing type universal joints, as shown in Fig. 1. Slip joint is used at transmission end, while at differential end a fixed joint is used, which is splined to propeller shaft. Transmission end is provided with propeller shaft guard welded to guard support, which is bolted to rear spring safety strap.

SLIP JOINT

Slip joint sleeve and fixed joint yoke are marked with arrows, as illustrated in Fig. 1. When joints are installed, these arrows must line up so that trunnion of each joint is in same plane. If marks are not legible, sleeve and yoke should be marked before disassembling.

UNIVERSAL JOINTS

Universal joints are each composed of two yokes, a journal, and four needle type roller bearings. Each bearing assembly is retained in yoke with a plate and two cap screws. Special locking plates under screw heads prevent loosening.

REMOVING PROPELLER SHAFT

When engine or rear axle is removed, propeller shaft can be taken apart at slip joint. If necessary to remove propeller shaft or universal joints for repair purposes when engine and rear axle are in place, the shaft can be disconnected at either the differential or transmission end. After slip joint sleeve is loosened, there will be sufficient movement in spline sleeve to clear flanges at either the transmission or differential end.

DISASSEMBLING SLIP JOINT

1. Before slip joint can be pulled apart, dust cap must be unscrewed from sleeve, or female member.
2. Look for arrow marks on shaft and sleeve. If these marks are not readily discernable, punch mark both members so that they may be reassembled in exactly same relative position. When clearly marked, withdraw shaft.

DISASSEMBLING UNIVERSAL JOINTS

1. Remove retaining bolts and lock plates. Bearing caps can then be removed.
2. Tap yoke lightly on one end until needle bearing assembly in opposite end drops out. Do this until all bearings are removed.
3. To take out journal, move it sideways as far as possible, then tilt journal so that it clears side of yoke.

CLEANING AND INSPECTION

1. Clean all metal parts, using gasoline or other suitable cleaning liquid. Allow needle bearings to remain in cleaner for some time to loosen up any particles of hard grease.
2. Needle type roller bearings should not be disassembled. Clean with short stiff brush and blow out with compressed air. Work small quantity of lubricant into roller assembly and turn bearing on trunnion to check wear. Inspect roller bearings. If side movement of bearing assembly is excessive on trunnion, worn bearing should be replaced.

ASSEMBLING UNIVERSAL JOINT

1. Make sure universal joint bearings are well lubricated before assembly.
2. Inspect journals and yokes carefully and hone out any burrs or rough spots on bearing surfaces and ends of journal pins.
3. Insert one trunnion of journal into yoke as far as possible from inside and tilt until opposite trunnion clears yoke and drops into position.

Wheels, Hubs, and Bearings

Instructions and Illustrations Shown in This Group Apply to Following Subjects:

Wheels
Wheel Bearings
Bearing Lubrication
Tires

Instructions Applying to Related Parts of Wheels will be found in Following Groups:

Name	Group
Front Axle	1.7601
Rear Axle	2.10281
Brakes	4.10401
Wheel Alignment	1.7601

Wheels are carried on two opposed tapered roller bearings. Bearings are adjustable for wear and their satisfactory operation and long life depend upon proper adjustment and correct lubrication. See Figs. 1 and 2.

BEARING ADJUSTMENT

Jack up wheels one at a time and check by shaking wheel endwise or by using long bar under tire. Observe movement of brake drum in relation to top of brake. If bearings are properly adjusted, movement of drum will be just perceptible and wheel will turn freely without undue drag.

If this test indicates that adjustment is necessary, proceed as directed below:

FRONT AND REAR WHEEL BEARING ADJUSTMENT

1. Rotate wheel at same time adjusting nut is being brought up tight. Rotate wheel in both directions, bringing nut up until all bearing parts are firmly seated and in proper contact.
2. A drag or resistance to rotation will be noted in wheel at this point.
3. Back off adjusting nut, three holes of lock ring. Wheel should rotate freely but without any perceptible shake.
4. Lock adjustment in this position.
5. Check bearing adjustment again to insure that wheel rotates freely without any perceptible bearing end play.

OIL SEALS

Oil seals at front and rear wheel bearings should be inspected whenever hubs have been removed, and replaced if necessary. Always install new seals at time of periodic cleaning and lubrication of wheel bearings.

LUBRICATION

Wheel bearings should be hand packed or lubricated with special bearing lubricator shown in Fig. 3. Always use proper lubricant as specified in Lubrication charts.

Grease should not be forced into bearings and hubs through lubrication nipples. All lubrication nipples on hubs should be removed and pipe plugs installed. If lighter lubricant than specified is used, and if applied with pressure gun, excess lubricant will be forced through bearing seals with resultant damage to brake linings. IT IS NOT NECESSARY TO PUT ANY GREASE IN HUB CAVITIES.

Under normal operating conditions, hub bearings require lubrication only every 10,000 miles. However, if vehicle is subjected to severe operation, bearings should be cleaned and repacked more often. At these intervals hubs and bearings should be removed, thoroughly washed in gasoline or kerosene, and inspected for pitted races and rollers. Inspect all hub seals and replace if necessary.

Bearings should be given more than a cursory cleaning. Use a clean, stiff brush and remove all particles of old lubricant from bearings and hubs. Bearings should be cleaned carefully, as already noted in axle sections.

After hubs are cleaned and inspected, roll a portion of lubricant into bearings. Use fingers or special lubricator for this operation and make sure all parts of bearing are packed with grease.

Bearing lubricator shown in Fig. 3 is very effective in providing supply of lubricant.

purpose. Tighten as securely as possible. DO NOT USE EXTENSION HANDLE ON WRENCH.

3. RE-TIGHTEN NUTS DAILY FOR FIRST 500 TO 1000 MILES TO OFFSET "SETTING-IN" OF CLAMPING SURFACES.
4. Inspect wheel nuts at least every 1,000 miles thereafter. (If vehicle is subjected to severe service, this inspection should be made daily regardless of the mileage.)
5. When changing wheels or tires and before assembling wheels to hubs, remove dirt, grease, and excess paint from the mating surfaces.

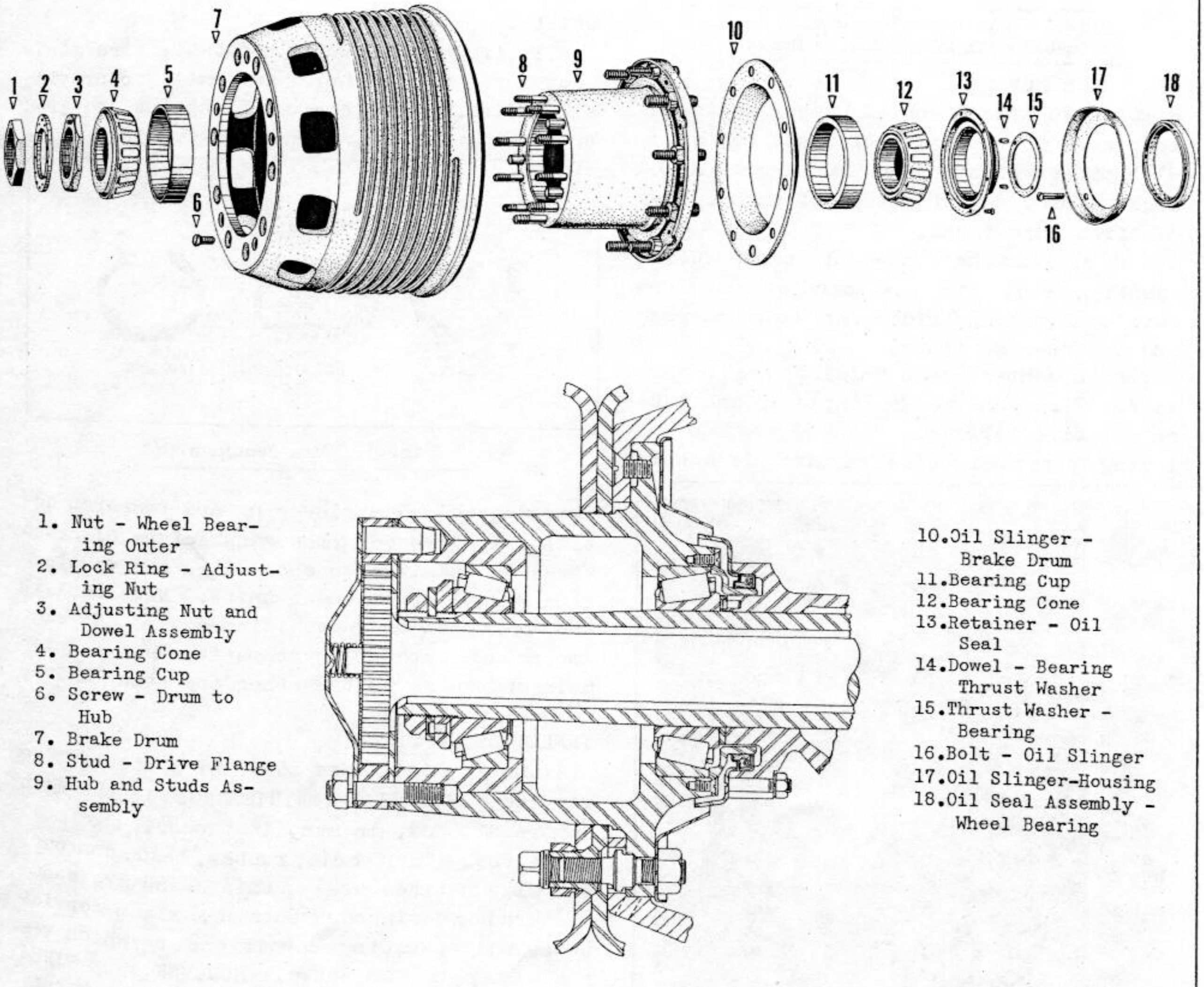
WHEEL MOUNTING

Dual wheels should be mounted as shown in Fig. 6. Care should be exercised in positioning tire valves and wheel spokes. By placing spoke openings as shown, access to both outer and inner tire valves may be more readily obtained.

SPARE TIRE CARRIER

Tire carrier is mounted in front of coach under floor and is accessible through tire carrier door. (See Fig. 4.)

19-125
19-116



1. Nut - Wheel Bearing Outer
2. Lock Ring - Adjusting Nut
3. Adjusting Nut and Dowel Assembly
4. Bearing Cone
5. Bearing Cup
6. Screw - Drum to Hub
7. Brake Drum
8. Stud - Drive Flange
9. Hub and Studs Assembly
10. Oil Slinger - Brake Drum
11. Bearing Cup
12. Bearing Cone
13. Retainer - Oil Seal
14. Dowel - Bearing Thrust Washer
15. Thrust Washer - Bearing
16. Bolt - Oil Slinger
17. Oil Slinger-Housing
18. Oil Seal Assembly - Wheel Bearing

Fig. 2. Sectional View of Rear Wheel Bearings and Component Parts of Hub, Drum, and Bearings.

tion of the vehicle will be materially affected. See Fig. 5.

VALVE CORE

Because tire service requires inflating, deflating and gauging of air pressures, a tire valve housing or stem is placed on the tube in a position where, after tube and tire are mounted, it is accessible for inflating tube to prescribed pressure. For convenience, an automatic check valve, or valve "core" is inserted in the valve stem for these operations. Any standard valve core efficiently performs its function as an "operating valve"; however, this valve core is subject to damage in service beyond human control. Consequently, the valve is not a positive seal to hold the compressed air in the tube. Therefore, cores should be inspected and renewed at regular intervals to prevent air leakage during inflation or gauging operations.

THE VALVE CAPS

Dirt, moisture, ice and other foreign matter, under ordinary service conditions, may permit air to escape through the valve core. The VALVE CAP is, then, the only medium to positively seal compressed air in a tube.

It is generally understood that valve caps keep out dirt and dust; therefore the erroneous impression that valve caps are mere "dust caps". Standard valve caps are designed with an inside sealing washer. This washer is the SEALING UNIT WHICH DEFINITELY SEALS THE COMPRESSED AIR IN THE TUBE WHEN CAP IS PROPERLY TIGHTENED ON THE VALVE STEM.

Insignificant in size, the valve cap is usually the most neglected part of the tire assembly, yet without this sealing device, proper inflation, a most vital necessity, cannot be maintained. IT IS IMPORTANT THAT THE POSITIVE SEALING CAPS BE REPLACED ON THE STEMS AFTER GAUGING AND INFLATING OPERATIONS.

CORRECT INFLATION

Every tire is designed and built to operate on a pre-determined column of compressed air. This operating air pressure, recommended by the tire manufacturers, is an essential to the safe, economical operation of the tire as the proper amount of oil would be to the engine or other chassis units. The tire may operate to a certain degree on more or less than the required air pressure, but not safely or economically.

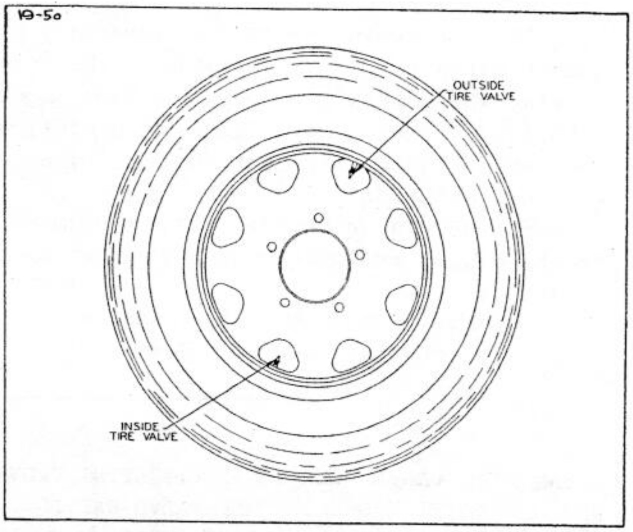


Fig. 6. Position Tire Valves So That Inner and Outer Valves Are Accessible.

An under-inflated tire runs sluggishly and quickly wears out with too much flexing. On the other hand, over-inflating a weakened tire may cause a blow-out. In addition to the deteriorating effect over or under inflation may have on the tire life, these conditions will affect steering, riding comfort, and safe driving. FOLLOW THE TIRE PRESSURE RECOMMENDATIONS OF THE TIRE MANUFACTURER.

BALANCED INFLATION

The whole efficiency of the vehicle will be upset if air pressures in the tires are out of balance. Balanced inflation may be expressed as the tires on the same axle should always carry the same pressure. A difference in air pressure of the rear tires and front tires may be permissible within certain limitations; however, there should not be a difference in pressures between the right and left tires on the same axle. A five-pound under-inflation in one front tire not only can destroy ease of steering, but creates steering hazards which generally point to a potential accident. An under-inflated rear tire can destroy the value of the most efficient brakes. BALANCE THE TIRES FOR EASE OF STEERING, COMFORT IN RIDING, SAFETY IN DRIVING, AS WELL AS FOR MINIMUM FUEL CONSUMPTION, AND MAXIMUM TIRE MILEAGE.

INTERCHANGING TIRES TO OBTAIN LONGER LIFE

Interchanging tires can result in a very material increase in tire life, therefore a

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